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ABSTRACT

This guide is a continuation of SE 012 726. Each section is organized under the same six headings: length, volume and capacity, weight, time, money, and spatial relations. A further section describes work on statistics and graphs which may be spread over the entire interval covered by this guide. A great number of activities are suggested, leading to appreciation of the following topics by the end of the course: measuring in inches, feet and yards, measuring in pints and gallons, measuring in pounds and ounces; telling time to the nearest minute; writing, paying and giving change in amounts up to one dollar; symmetry; solids; parallels; vertical and horizontal; maps; data collection; sorting; and illustration. (MM)

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CURRICULUM GUIDE

APPLIED NUMBER COURSE

SECTIONS D, E, F

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GENERAL INTRODUCTION

The Curriculum Guide for Applied Number, Sections A–F, is presented in two parts, one covering Sections A, B, C of the course and the other, Sections D, E, F.

Aims

The aims of the course are set out in the Course of Study in Mathematics, 1967, and throughout the Guide, but in broad outline these aims may be stated as the development of :

(i) comparison—as exemplified by measurement ;
(ii) exploration of the environment ;
(iii) skills—among these, estimation and computation ;
(iv) language—as a medium for accurate description.

This development takes place through continuous and challenging experiences with concrete materials, participation in planned activities, and opportunities for individual discovery.

Comparison and Exploration

In the early sections of the course the child learns to compare attributes, such as length, weight, colour, shape, and size, to discover both similarities and differences. Later, he learns to measure the attributes of length, weight, and capacity, using informal units so that he can express these attributes more precisely. From these activities he becomes aware of the need for common and, later, standard units of measurement. He also comes to appreciate the need for greater precision in measurement. In all these activities mathematics becomes an important tool for exploring the child's world in a quantitative manner. Similar needs arise in the topics of time and money as the child begins to develop ideas of duration and equivalent value. In the field of spatial relations the child develops an increasing ability to describe the objects in his environment in terms of shape and location and explores his world in a non-quantitative manner.

Skills

As will be seen from the notes that follow, a continuing emphasis is placed upon skills such as the manipulation of materials and equipment, the developing ability to estimate, and, later in the course, to compute. In the past, great emphasis was placed upon computational skill. The attainment of such skill remains an important part of the present course which, however, demands that prerequisite understandings be attained before formal computation begins in Section G.

Language

The development of the child's ability to communicate with increasing precision is an integral part of the course. Vocabulary should arise from the child's need to express himself meaningfully, using terms which he understands to describe what he sees, what he has done, and the conclusions he has reached. The use of technical language is justified only when it serves to clarify, rather than to inhibit, understanding. The language used by the child becomes an important tool to assist the teacher to assess the child's learning and understanding.

The Use of Materials

Reference to the Guide will show that the course is one in which the child constantly works with materials and equipment rather than passively accepts instruction. It is the use of these that assists the child to discover relationships and to gain experience. The materials mentioned in the Guide are by no means prescriptive, and teachers should avail themselves of every opportunity to add to those listed, particularly from the local area.

Activities

In the early sections of the course the child, through free play, discovers many of the properties of the materials at his disposal; but after this initial period his activities become directed towards a particular goal. The same pattern should be followed whenever new materials or ideas are introduced at any level. Increased maturity and confidence will allow him to make use of his own initiative to solve problems, investigate relationships, and describe the environment in which he lives.

The Role of the Teacher

The provision of materials and equipment and appropriate situations for their use is an important part of the teacher's task. However, it is vital that through discussion the teacher should guide the child so that he may obtain the greatest value from his discoveries and his experiences. The child should be encouraged to appreciate that problems may be solved in a variety of ways and, later, he should be encouraged to initiate his own investigations.

The Role of the Guide

Each teacher has the responsibility of interpreting and presenting the course to her own class. This Guide has been prepared to assist in this. It is hoped that teachers will not limit themselves to the material of the Guide, but, as alternative worth-while approaches are suggested from other sources, they will feel free to incorporate them.

SECTION D

INTRODUCTION

In this section the child is led to realize the need for units of measurement which are smaller than, but related to, the standard units of foot, pound, and pint. By dividing the pound and the pint into equal parts he gains new units for measurement which are large enough to be handled conveniently. Although the child comes to appreciate the need for the inch, it is not until Section E that this unit is used freely as a standard measure.

Maintenance

It is an underlying principle that any aspect of the course introduced in earlier sections should continue to be a part of the child's activities, geared to his level of development.

Teachers should refer to the preceding sections of the Curriculum Guide for introductory discussions of various matters in question and to ensure that the activities are maintained.

Three of these matters are :

Initiative :

Problem solving, an integral part of the child's development, should be catered for. The amount of direction given in activity work varies, but should be kept to a minimum so that the child can devise his own method of solution as often as practicable.

Open-ended situations, where the child is able to investigate at his own level of understanding and interest, should play a large part in activity work.

Refer to the introduction to Section B.

Estimation :

This is a skill which should be developing. Whenever possible the child should estimate his answer and check this by measuring.

Refer to the introduction to Section B and also to the notes on Volume and Capacity, Section B.

Conservation :

The child's awareness of the principle of conservation should be appraised as the opportunity arises.

Activities designed to give experience in conservation should continue through all sections, and it should be appreciated that this principle holds for all forms of measurement, not merely for capacity. While some children may appreciate the principle, no child is expected to formalize or give any definition of it.

Refer to the introduction to Section B and also to the notes on Volume and Capacity, Section C.

SECTION D—LENGTH

NOTES

The Inch

Throughout the applied number course, the child has been encouraged to use appropriate units of measurement. With the introduction of the foot as the standard unit, the child is faced with the problem of measuring lengths less than one foot. He will have met this earlier in his measurement :

> "This stick is two feet long and a bit."

and also in his observation of the height chart :

> "Mary is a bit taller than three feet."

In the notes on Length, in Section C, it was suggested that informal units could be used to overcome this problem. The child's early activities in Section D should be to discover things which are one inch long, so that he can become familiar with the unit and also have a selection of units from which to choose.

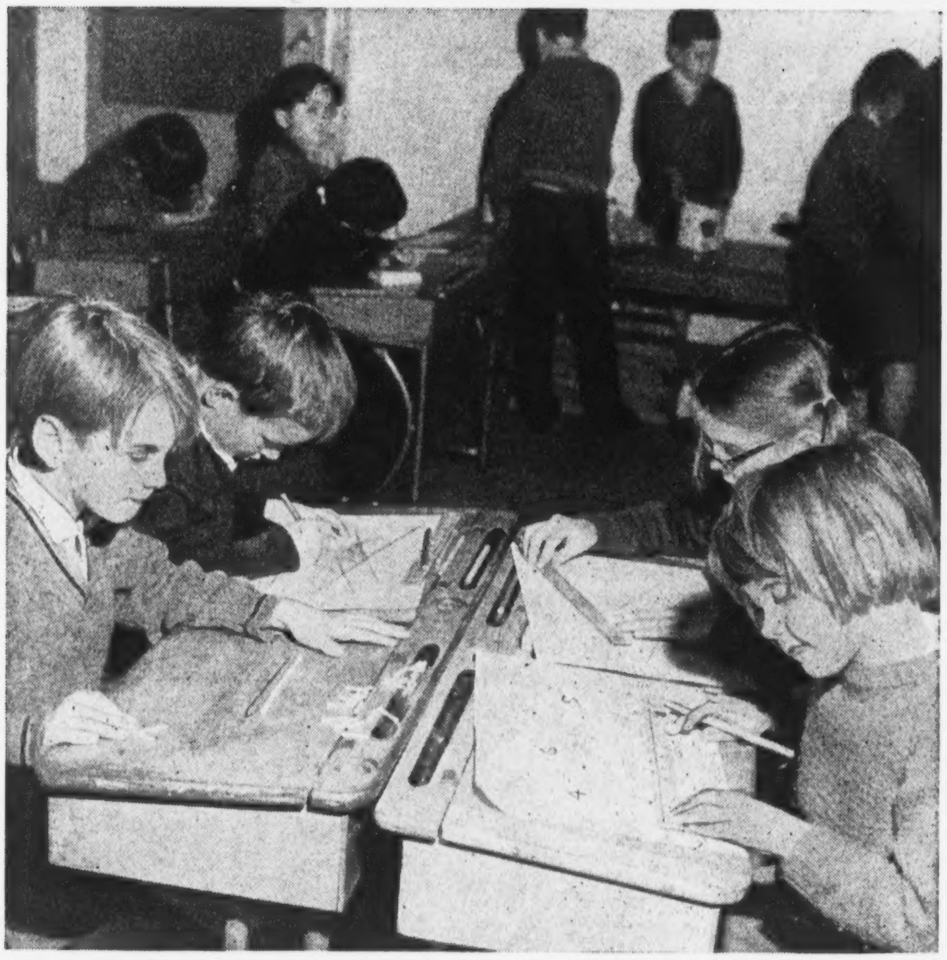
It is in Section D that the need for, and use of, this smaller unit becomes firmly established. The child is encouraged to use the ruler, or material cut into lengths of one inch, so that he can measure more accurately. Such material should be rigid and appear linear to avoid confusion with area, as would be the case with one-inch plastic tiles, or with volume if inch blocks were used. One-inch lengths cut from plastic sticks, matches, plastic drinking straws, and similar materials are effective. Ribbon, string, and material of this type are unsuited to the purpose because they have a tendency to curl.

The child should not be asked to measure lines of a given length at this stage. The inch replaces small, informal units to some extent. Some children may discover the relationship between this small unit and the foot.

Measuring

With increased knowledge through his work in pure number, the child is able to employ more units in his work in applied mathematics. His measuring should not be confined to short lengths, but should be extended, so that the information recorded in the "Interest Centre" (ref. notes on Length, Section C, page 75) can reflect his increasing interest in, and awareness of, larger numbers.

By Section D, the routine of estimating and then checking measurement should be firmly established, so that even when not asked specifically to estimate, the child continues to make this his initial step in solving a problem.



The Ruler

It was suggested in Section C that the child should use one-foot lengths of wood rather than rulers marked in smaller units. In Section D he will begin to use a ruler, preferably marked only in inches. Both the length of wood and the ruler are, in these cases, tools for measurement.

In Section D, the ruler also becomes a tool for drawing straight lines To use ruler and pencil for this purpose is a skill demanding a certain degree of manual dexterity, and the child should be encouraged to develop this through free play. As the child gains in confidence and skill, the teacher can begin to provide direction.

Work with the ruler may be related to spatial relations. The child can be asked to look for shapes made by the lines he has ruled in any direction on his paper :

Colour in all the triangular shapes you have made.

Colour in each rectangle you can see.

Colour in two shapes next to each other in red so that you make a new shape. Find two more and colour them in blue.

Outcomes

By the end of Section D the child should—

- (*a*) realize the need for a formal unit smaller than the foot—the inch ;
- (*b*) be able to estimate short lengths, and in particular whether a length is greater or less than one foot ;
- (*c*) have developed manual dexterity so that he can rule lines competently.

SUGGESTED ACTIVITIES

Notes

It is important that teachers should note the following :

- (i) These activities—
  - are suggestions only ;
  - are not presented in any special sequence ;
  - do not represent all possible activities for the topic.
- (ii) The activities may be used as a basis for—
  - activity or assignment cards ;
  - individual or group activities ;
  - discussions within groups or with individual children.
- (iii) Each activity may be used as—
  - an activity complete in itself ;
  - an idea which may be presented at a higher or a lower level of difficulty ;
  - the core of a series of activities.
- (iv) Because of the printed form in which these activities are presented, they appear formal. To use them to the best advantage teachers should ensure that they are not presented merely as " bits of work ", but are used in such a manner as to become integrated parts of a developmental and informal program.
- (v) A child who has done only the activities suggested here has not " done the course ".

  A careful reading will show that only some aspects of the course are highlighted, and teachers will still need to develop activities for themselves to ensure that the child's experiences are sequential and that he has gained a full understanding.

Activities

Find three things longer than one foot.

Find four things shorter than one foot.

Find one thing equal to one foot.

Put them in order. Measure to find out if you were correct.

★

Provide strips of card or other material ranging in length from one inch to one foot.

Place these strips in order from the shortest to the longest.

Now place any three strips end to end. Guess how long this length is.

Measure with a ruler. Were you correct ?

Do this with three more strips.

★

Fill the gaps :

○ plastic sticks end to end are equal to one foot.

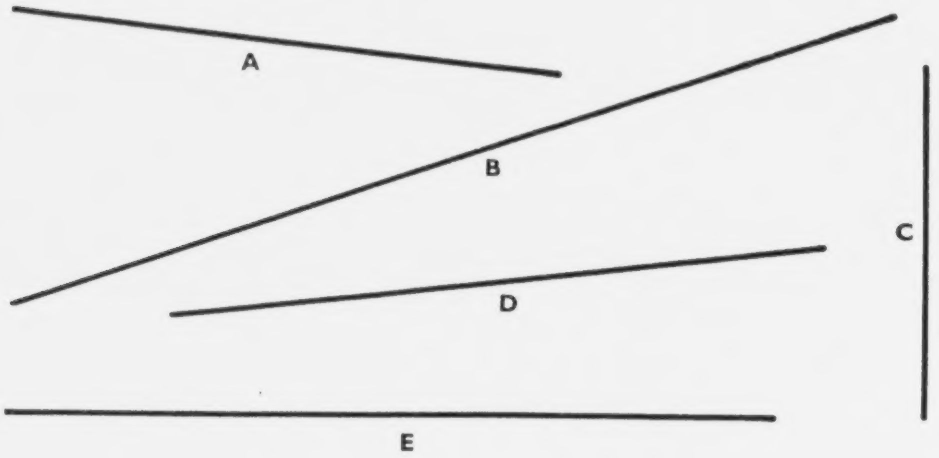
○ bottle tops side by side are equal to one foot.

○ matchboxes end to end are equal to one foot.

○ counters end to end are equal to one foot.

★

Which of these lines do you think is the longest ? Starting with this one, put them in order. Estimate their lengths, then measure them. Were you correct ?



★

Put four matchboxes end to end. Fill the gaps in the sentences below, but guess first and then measure.

☐ sticks of chalk, end to end, would be the same length as the four matchboxes.

☐ counters, end to end, would be the same length as the four matchboxes.

☐ short, plastic sticks, end to end, would be the same length as the four matchboxes.

☐ matches, end to end, would be the same length as the four matchboxes.

★

Provide a number of strips of card, two of which measure six inches each.

Find two strips which are the same length and together make one foot.

Now put the strips away and then fill the gaps, using the words "longer than", "shorter than", or "the same as":

My chalkboard is ☐ the strips end to end.
A stick of chalk is ☐ the strips end to end.
The duster is ☐ the strips end to end.
The milk bottle is ☐ the strips end to end.
Now measure. Were you correct ?

★

Ask the child to guess the distance between two points, to measure this distance, and then to write a sentence about the activity.

Distances could be—
from the table to the door ;
from the library to the cupboard ;
from the locker to the chalkboard.

Allow the child to use his own units of measure but, if he does not use the foot, suggest that this could be the final choice of unit.

★

Many opportunities may be found in the classroom for practice in estimating length. Encourage each child to estimate and then to measure so that he can see if his skill is developing. The following activities are suggested :

What is the longest thing in the room you could measure ?
What is the shortest thing in the room you could measure ?

Measure the cupboard.
Find three things shorter than the cupboard.
Guess their lengths and then measure them.

Find three things longer than your table.
Guess their lengths and then measure them.

Make shapes on the floor with plastic sticks.
Guess the lengths of the edges. Measure them.

Billy is to jump six times along this line.
How far has he moved ?
Ian is to take ten paces along this line.
How far has he moved ?
Who moved the farthest ? By how much ?

SECTION D—VOLUME AND CAPACITY

NOTES

Ideas of Volume and Capacity

In previous sections numerous experiences have been provided to lead the child to understand that two or more containers may be—

of the same size, shape, and capacity ;
of different shapes and have different capacities ;
of different sizes and have different capacities ;
of different shapes and have the same capacity.

In Section D, this understanding may be consolidated and the child may come to appreciate capacity as an interior measurement, that is, a measurement of what a container will hold, not a measurement of the container itself. That this is difficult for even adults to appreciate is evidenced in the packaging of certain merchandise, when the outside dimensions of the container are such that the apparent capacity is greatly in excess of the actual capacity.

No formal definition of capacity is required from the child, but teachers should avail themselves of every opportunity to ask questions and to set up situations which will assist in evaluating the child's understanding.

Parallel with this understanding should be the appreciation of the fact that shape may be altered without loss of volume. Many of the activities where clay, dough, and damp sand are used are designed to assist in this understanding. A collection of containers showing wide variations in shape—tall, squat, narrow, flat, wide—should be available so that the child can pour from one to another to compare capacities, to continue ordering and matching activities, and to see what happens when a constant amount of water is poured into various vessels of different shapes.

Standard Parts

In Section C, the child discovered that the standard unit would not always measure exactly the capacity of certain containers. As a result, it was necessary to select an appropriate unit for the excess liquid :

" My bucket holds two pints and one cupful."

In Section D, the child is given the specific task of finding the half-pint and also, because of its importance in the daily milk distribution, the one-third-pint. It can be seen that a close link can develop between pure and applied number, and teachers should ensure that this is established. Activities can be prepared so that the relationships of the pint to the half-pint and the one-third-pint are well understood and used effectively.

Volume

Packing exercises should continue in this section. Here the child may be concerned with the volume of the objects he is using, that is, the amount of space the objects will occupy, or he may be looking at the container and judging its capacity. It is also important that the child should be given opportunities to make different arrangements of the same number of blocks without using a container, so that he may begin to gain some idea of volume.

As well as activities planned along lines similar to those of preceding sections, practical situations can be set up involving selecting the best place to store equipment ; choosing the best box to hold blocks, cubes, or balls ; finding the best method of storing clay ; and similar problems.

Informal Units

Throughout Section D, the child should be encouraged to use informal units, to estimate, and to check these estimations by accurate measurement.

Outcomes

By the end of Section D the child should be able—

(*a*) to find and use the half-pint and the one-third-pint as units of measurement ;

(*b*) to pack materials into appropriate spaces or containers ;

(*c*) to appreciate relationships with respect to shape, size, and capacity.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section D, page 122.

Find three jars of different shape that you think hold more than a pint. Put what you think is a pint in each jar.

Measure. Were you correct ? Did all the containers hold more than one pint ?

How many half-pints do you think each jar will hold ?

Measure. Were you right ?

★

Provide a pint measure, a cup, and a beach bucket.

Guess first and then measure :

☐ pints fill the bucket ;

☐ cupfuls fill the pint measure ;

☐ cupfuls fill the bucket.

★

Using the same equipment as above, results may be recorded on prepared cards :

Guess first and write your guess in the circle. Then measure and write your answer in the square.

How many pints fill the bucket ? ○ ☐

How many cupfuls fill the pint measure ? ○ ☐

Will there be more pints than cupfuls needed to fill the bucket ? ○ *Yes* ☐ ○ *No* ☐

How many cupfuls will fill the bucket ? ○ ☐

How many of your guesses were correct ?

★

Similar activities may be devised for discovering relationships between the half-pint and the one-third-pint.

Use a one-third-pint bottle and three one-pint bottles.

It will take △ one-third-pints of water to fill one one-pint bottle.

It will take △ one-third-pints of water to fill two one-pint bottles.

It will take △ one-third-pints of water to fill three one-pint bottles.

Guess first and then measure.

★

How many ½-pint bottles of water fill a ½-pint bottle ?

How many ⅓-pint bottles of water fill a 1-pint bottle ?

The pint jug holds △ ⅓ pints of water.

The two-pint jug holds △ ½ pints of water.

Find a container that holds more than two pints.

How many ⅓ pints does it hold ?

How many ½ pints does it hold ?

Now guess how many pints it holds. Measure and see if you were correct.

★

Fill the gaps. Write your guess in the circle. When you have measured, write the answer in the square.

○ ☐ pints fill the jug.

○ ☐ cupfuls fill the jug.

○ ☐ jarfuls fill the jug.

○ ☐ mugfuls fill the jug.

○ ☐ egg-cupfuls fill the jug.

Put your containers in order, from the one that holds the most to the one that holds the least.

★

Provide a wide variety of containers from which the child can choose.

Ask the child to select according to capacity :

Five containers which each hold more than (one pint, one half-pint, one third-pint, etc.).

Four containers which each hold ($\frac{1}{3}$, $\frac{1}{2}$, or 1 pint).

Ask the child to choose containers of different shapes for all exercises of this type.

★

Provide containers as above and ask the child to compare capacities, filling the gaps in the sentences with " more than ", " less than ", or " the same as " :

The cup holds ☐ one half-pint.

The mug holds ☐ the cup.

Many variations are possible.

★

Provide a one-pint bottle, a two-pint jug, a three-pint saucepan, and a four-pint billy-can.

Put these containers in order from the one that holds the least to the one that holds the most. How much do you think each one holds ? Measure.

Now guess and fill the gaps below :

☐ bottlefuls fill the jug.

☐ bottlefuls fill the saucepan.

☐ bottlefuls fill the billy-can.

☐ jugfuls fill the billy-can.

Measure. Were you correct ?

★

How many pints fill the billy-can ?

How many half-pints will fill the billy-can ?

Fill the billy-can with water. How many school milk bottles can you fill with this water ?

How many pint bottles can you fill with this water ?

Guess first and then measure.

★

Pour what you think is one pint into each of these containers—

the kettle ; the bowl ;

the jug ; the billy-can.

Measure. Were you correct ?

Now try again with two pints of water.

SECTION D–WEIGHT

NOTES

In the preceding sections of the course one aim has been to allow the child's experiences to lead him to appreciate the convenience and the importance of the standard, or formal, unit—the pound.

In Section C it would have become evident that such a standard could be an accurate measure of weight only when multiples of the pound were to be weighed. The child had to devise some means of measuring any weight in excess of one pound. It was suggested that this could be done by using informal units :

> "This piece of clay weighs a bit more than one pound."
>
> "My tin of shells weighs two pounds and two bolts."

In Section D, the child is introduced to a unit smaller than the pound—the half-pound. This should be found by halving the pound, and many experiences should be given to ensure that integration occurs to link the work he is doing in applied number with the knowledge he has gained in pure number.

The child is now able to weigh smaller quantities, and it is important that the teacher, having introduced him to the half-pound, should let him estimate and weigh this amount using many different materials. From this the child should be able to understand that—

- (i) any material weighed exactly against a one-pound weight may be used as a standard of weight ;
- (ii) any of these standard weights, when divided equally, will provide two standard half-pound weights ;
- (iii) any two half-pound weights, when weighed together, will give a standard one-pound weight.

These ideas may be reinforced when accurately weighed packets are labelled and used either as weights or as part of the classroom shop.

It is important that in Section D, as in all preceding sections, materials of different densities should be used in weighing activities in order to keep in front of the child the fact that a small parcel may weigh more than a large one, and so on.

Outcomes

By the end of Section D the child should be able to—

- (*a*) estimate whether an object weighs more or less than one pound ;
- (*b*) use the pound and the half-pound accurately, with both standard and informal weights.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section D, page 122.

Provide a one-pound standard weight, beans, sand, and a balance.

Use the one-pound weight to measure one pound of beans.

Now use the beans to balance the sand.

Weigh the sand with the one-pound weight. Write a sentence about what happens.

Find something else to weigh with the sand.

★

Put a tick beside the names of the fruit and the vegetables that the greengrocer weighs :

▽ lettuce
▽ bananas
▽ strawberries
▽ celery
▽ potatoes
▽ onions
▽ apples
▽ oranges
▽ carrots
▽ peas
▽ cherries
▽ pineapple

Make a list of any other things you can think of that he would weigh.

★

Provide plastic bags of various sizes and the materials as listed in the exercise.

Guess first and put a tick in the circle. Then measure and put a tick in the square.

Which would need the bigger bag in each of these pairs ?

○ one pound of nails ☐
or
○ one pound of chalk ☐

○ one pound of stones ☐
or
○ one pound of matches ☐

○ one pound of beads ☐
or
○ one pound of batteries ☐

○ one pound of sawdust ☐
or
○ one pound of plastic foam ☐

How many times did you get the two ticks together ?

★

The child puts in a bag what he considers to be one pound, or one half-pound, of stones, blocks, or other material. He then checks his estimate using the balance.

★

Provide plastic bags of uniform size and the materials listed in the exercise.

Fill bags with sand, chalk, nuts, acorns, corks, blocks, and plastic foam.

Now see if you can halve the material in each bag by guessing. Check each one on the balance.

Which was the easiest one to halve ? Write a sentence about it.

★

Weigh out one pound of peas ; one pound of fruit stones ; one pound of oatmeal.

Divide each pound of material between two bags, so that each bag will weigh one half-pound.

Guess first and then check with the balance.

★

Estimation activities play a large part in every section. These may be presented in a number of ways.

Find three things on the table each of which you think weighs more than one half-pound.

Find two things that you think each weigh one half-pound.

Find one thing that will weigh less than half a pound.

★

Provide a cupful each of stones, beads, water, chalk, clay, and so on, and ask the child to sort them into groups weighing less than one half-pound, more than one half-pound, or the same as one half-pound.

The same activity can be adapted for estimation of one pound.

★

Present the child with a number of materials to weigh, for example, sand, peas, sawdust, plastic foam, and stones. He is allowed to choose for each of these a container into which he estimates he can put one pound of the material. Having done this he checks his guesses by using the balance.

★

Guess first and then weigh into each bag one pound of rice, one pound of shells, one pound of beans, one pound of metal, and one pound of gum nuts. Now put ticks beside the sentences below that are true :

The bag of rice weighs less than the bag of metal.
The bag of metal weighs more than the bag of shells.
The bag of rice weighs the same as the bag of gum nuts.
The gum nuts need the biggest bag.
All the bags weigh the same.

Check with the balance to see if your answers are correct.

★

This activity could be used with a group of children and is more effective if the teacher can give the instructions orally as the activity progresses.

Balance each of these things with marbles—

a torch battery ;	ten plastic sticks ;
a wooden block ;	ten acorns.

Write down the number of marbles it takes to balance each of these. (Each child can be responsible for one thing, or the group may have a " recorder ".)

Put the torch battery on one side of the balance. Balance this with marbles. Did you need the same number as you have on your list ?

Add the ten plastic sticks to the torch battery. Balance using more marbles. How many marbles did you add ? Check with your list.

Add the wooden block and then balance with marbles. How many did you need to add ? Check with your list.

Add the ten acorns. Guess how many marbles you will need to add to balance. Do this and then check your list.

Add all the marbles you had on your list.

Count all the marbles you have on the balance.

Can you write a sentence about what happened ?

★

Fill a small bucket with sand. Weigh this and then fill the gaps :

The sand weighs ○ pounds and ○ gum nuts.

Empty the bucket and fill it with macaroni. Weigh this and then fill the gaps :

The macaroni weighs △ pounds and △ gum nuts.

Which weighs the more ?

Find two other materials to weigh and use marbles instead of gum nuts. Write a sentence about what you discover.

★

Find five bags of the same size. Fill each bag with a different material—beans, corks, clay, wet sand, milk-bottle tops.

Place the bags in order, from the heaviest to the lightest.

Now, by guessing, write in *Yes* or *No* beside each of these sentences :

Each bag weighs more than one pound. ☐
Each bag weighs less than one pound. ☐
The sand weighs more than one pound. ☐
The milk-bottle tops weigh less than one pound. ☐
The corks weigh more than one pound. ☐
The clay weighs more than one pound. ☐

Check on the balance and tick the answers you had correct.

SECTION D—TIME

NOTES

In previous sections of the course the foundation for the child's understanding of duration has been laid, and this has been linked to the routine of the day and the movement of the hands of the clock.

Parallel with this understanding has gone the development of a vocabulary which allows the child to express some of his ideas.

In Section D the child should—

- (i) enlarge the "time span" encompassed by his vocabulary so that he can talk about events outside the range of "last week", "this week", and "next week". He will become more conscious of the month as a unit of time as he learns the names of the months, though not necessarily in sequence ;
- (ii) extend his appreciation of the immediate measurement o time by using the half-hour.

The Clock

It is essential that a real clock and a clock with synchronized hands be in the room and readily accessible. The child's attention will often be drawn to the position of the small hand. Only by using a clock where this hand moves in relation to the position of the large hand can the child accurately indicate a given time.

These clocks should be used to link the time with daily events, to give practice in telling the time in hours, and to allow the child to become familiar with the clock as a piece of equipment.

When the child is able to—

- (i) show any stated hour on the clock-face ;
- (ii) tell any hour from the clock ;
- (iii) record the time in hours ;

the teacher should then introduce the half-hour.

It will be necessary, for recorded work and in evaluating the child's understanding, to provide accurately drawn clock-faces. These may be duplicated, drawn on prepared cards, or printed using rubber stamps which are readily available. Teachers should select such stamps with care, remembering that in this section one-minute intervals are not needed.

The Half-hour

Since the child has realized the position of both hands of the clock "on the hour", it is important that both hands should be observed for the half-hour and that the child should appreciate the movement of the small hand rather than merely note that "the large hand points to six". It is also important to relate the meaning of the half-hour to the work he understands in fractions.

Tuesday
20th
August

The child may be encouraged to watch both hands as they move around the clock. If the hands are of different colours, the relative movements may be easier to follow. Discussions concerning events of half-hour duration can be interesting and valuable.

Many of the activities linked with the earlier work on telling the time in hours can be adapted to work on the half-hour.

Throughout all this work the child will be aware that there are shorter units of time than the hour and the half-hour. His work on duration will show that there can be informal units, and he will have heard the words " minute " and " second ". However, because of the precision involved, these smaller units of measurement of time do not feature in the course until later sections.

The Day, the Month, and the Year

Work on routine and sequence can lead to discussion of the hours in the day, the manner in which the day is divided, and the introduction of such terms as midday, midnight, and noon.

The child is now conversant with the names of the days and their order in the week. Discussion about this cycle and events past and present helps the child to understand the longer units of the month and of the year, though his ideas on the latter will be rather vague and his point of reference will probably be a festival such as Christmas or his own birthday, rather than January 1.

Useful links with birthdays, seasons, and holidays can be made when discussing the months.

The Calendar

Just as the weather calendar, the daily diary, and the recording of activities were used to lead the child to learn the names of the days and place them in sequence, so the conventional calendar itself may be used to implement teaching of the names of the months. Such a calendar must be clearly set out, and the divisions into weeks and months should be simple and distinctive.

Much discussion can arise from a study of the calendar, and the child's interest can be maintained by marking off the days. This activity can readily be related to the writing of the date for the daily diary and also to the seasons of the year.

Because of his experiences in keeping a daily diary or in taking part in class news discussions, the child should be able to read the date as recorded in the teacher's particular manner. It is also possible that some children may be able to record the date following this pattern.

Outcomes

By the end of Section D the child should be able to—

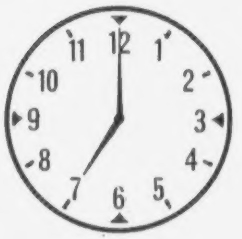
(*a*) read the date ;
(*b*) tell and record the time to half-hours ;
(*c*) know the names of the months, not necessarily in sequence.

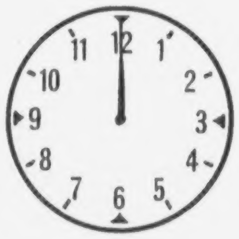
SUGGESTED ACTIVITIES

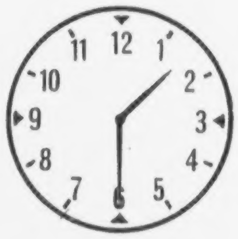
Refer also to the notes on the suggested activities for length, Section D, page 122.

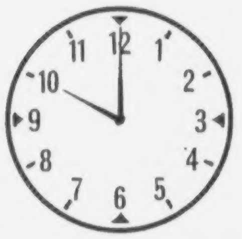
Prepared cards are used, each having a clock-face with the hands set at a given time.

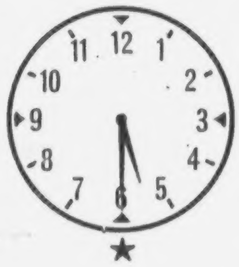
Arrange these clock-faces in order, beginning with the one that shows twelve o'clock.

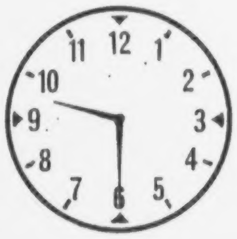












In this exercise the gaps may be filled either by the insertion of a card or by having the child write in the appropriate word.

Fill the gaps :

The name of yesterday was ☐.
Tomorrow will be ☐.
Bank day is on ☐.
We salute the flag on ☐.
☐ and ☐ are called the week-end.

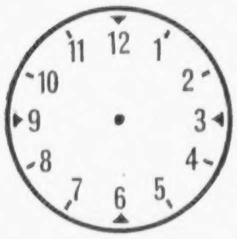
Choose from these words :

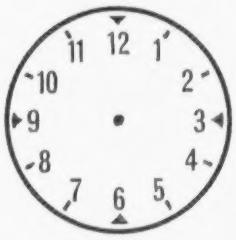
MONDAY TUESDAY WEDNESDAY THURSDAY FRIDAY SATURDAY SUNDAY.

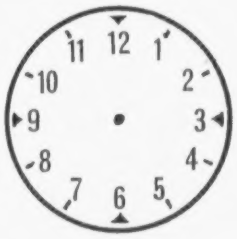
★

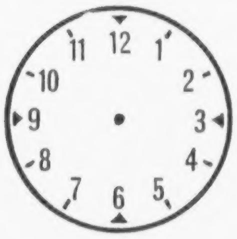
The child should have much practice in the reading of the clock. A recorded activity, such as this one, allows the teacher to discover whether the child understands the movements of the hands of the clock. It could be of value to carry out the activity, first using the clock, and then allowing the child to record.

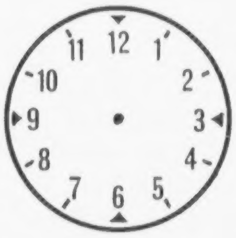
On these clocks mark the times shown. Mark in the small hand, using blue, and the large hand, using red.


three o'clock


½ past six


half past seven


8 o'clock


nine o'clock

½ past 2

★

Cards stamped with clock-faces are provided.

Mark on the clock-faces :

Midday.
An hour before midnight.
Noon.
An hour after midnight.
An hour past noon.
Midnight.

SECTION D—MONEY

NOTES

In this section the child's awareness of money and its value becomes greater because, in many cases, he gains personal experience in handling it both for himself and on behalf of his mother as he carries out errands. In some rural areas this may not be so, or it may happen only on rare occasions.

Because of experience outside the classroom and the differences that exist from family to family, teachers will find wide variation in the child's understanding of money.

The task of the teacher is to provide experiences and opportunities for discussion so that the child can handle money confidently. Although the child, in real life, continues to be influenced by what he wants to buy, he should be beginning to realize that money provides a measure of worth and that the amount of money he has is a limiting factor to what he can obtain.

Shopping

Many opportunities exist for the integration of the work in pure number with that in money and the use of the classroom shop. The handling of coins provides a concrete number situation and allows the child to gain experience in number relationships.

No change should be involved in transactions between ten and twenty cents. Thus, if a child wishes to buy goods totalling twelve cents he should tender the correct money.

If the transaction involves money up to ten cents, he can tender any coin or coins he likes to select and change can be given, if necessary, but he may buy only one article. When more than one article is to be bought the correct money must be tendered.

Variety can be added to the classroom shop by including goods to be sold by the pound and, later, by the half-pound. Similarly, the pint may be introduced early in this stage, and then, as the child develops the work centred on the half-pint and the one-third-pint, these measures may become part of the stock-in-trade.

Equivalent Value

The whole range of coins, and combinations of these, can be used for gaining an appreciation of equivalent values. Number knowledge will again play an important part in this work, and teachers, aware of this, will be able to devise activities that will allow the child to gain confidence in this aspect of the work. The fifty-cent coin should be introduced for recognition.

Opportunities should be taken to discuss aspects of value and to allow the child to appreciate these in simple terms. Practical application of these ideas can come from spending lunch money and the purchasing of school requisites from time to time. The child will see a range of articles such as pencils, rulers, erasers, and the like, which show a wide variation in price, and he will have to decide which he can buy with the money at his disposal and, also, which will give him the greatest satisfaction.

Outcomes

By the end of Section D the child should be able to—

(*a*) shop within the limit of twenty cents, buying more than one article, with no change involved ;

(*b*) give change up to ten cents from the purchase of one article ;

(*c*) have a knowledge of equivalent values to twenty cents ;

(*d*) recognize coins to fifty cents.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section D, page 122.

Put out a twenty-cent coin.

Put out the same amount using—

one-cent coins ;
two-cent coins ;
five-cent coins.

Can you put out twenty cents in any other ways ?

★

You have ten cents. How much change will you get if you buy a whistle ?

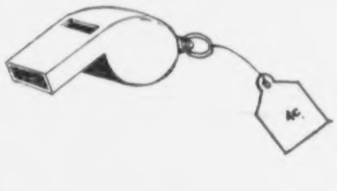
Put out a ten-cent coin.

Put out the change you should receive.

Put out the four cents in another heap.

Can you write an equation about this money ?

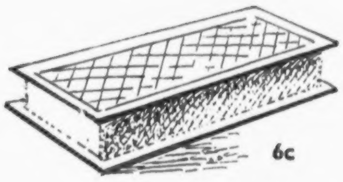
Can you put your change out using different coins ? Do this in as many ways as you can.



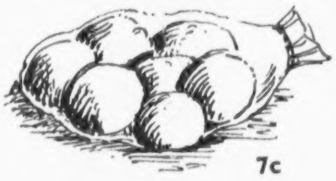
★

You have a five-cent coin, a ten-cent coin, two two-cent coins, and a one-cent coin.

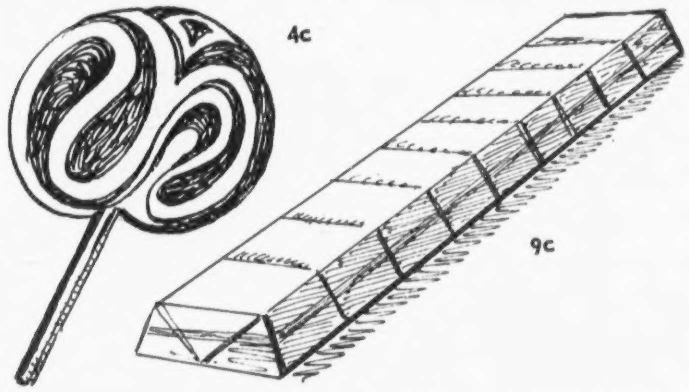
Without needing change, which coins would you use to buy this ice-cream ?



Which coins would you use to buy this bag of lollies ?



Which coins would you give the shopkeeper for these sweets ?



Which two articles could you buy with your ten-cent coin and not receive any change ?

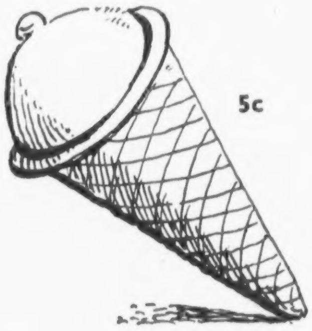
★

How many ice-creams can you buy for ten cents ?

How much change would you get ?

How many cents would you need to buy three ice-creams ?

Put out the money for three ice-creams in as many ways as you can.



SECTION D–SPATIAL RELATIONS

NOTES

In Section D, the work of earlier sections is consolidated and extended and continues to centre on—

(i) recognition of shapes, both when seen as models and when suggested by the outlines of objects in the environment ;

(ii) the child's environment in terms of space and location.

Reference to the discussion of these topics in the preceding sections should give teachers a firm basis for planning further suitable activities.

Work with shapes should continue to be creative. In earlier work the child discovered a relationship between formal shapes and other objects, for example, a circle and a wheel. As an extension of this, he should now be able to see in the environment shapes which are almost formal :

"When I look at Billy's face I can see a shape that is almost an oval."

"My orange has been cut so that this half of it is almost a circle."

"The shadow of that tree is almost a triangular shape."

Two further aspects are introduced at this level :

(i) Ideas of symmetry ;

(ii) the recognition and the drawing of both straight lines and curved lines.

Symmetry

A number of simple activities can lead the child to discover the idea of symmetry or " balance " :

Fold paper ; cut a shape starting on the fold and finishing on the fold ; open out the shape so made and also look at the " hole " in the paper ;

fold paper ; prick a line of holes through, starting and finishing on the fold ;

fold paper ; open it and draw a line, using pastel or soft pencil, which starts on the fold and finishes on the fold ; fold the paper again and rub firmly to transfer the line from one side of the paper to the other ;

fold the paper ; open it and add a drop of ink or poster colour to the fold ; close the paper and rub ; then open to observe the shape that has been made.

Children who have discussed the idea of symmetry arising from activities such as these may be encouraged to look for examples in nature—the butterfly with extended wings provides a simple illustration. Children can begin to appreciate such bilateral symmetry, and this leads to the extension to other types of symmetry in later sections of the course.

Lines

Practice in ruling, which begins in Section D as discussed in the notes on Length (page 121), may be linked, as suggested in the notes, with the discovery of shapes as the result of free ruling.

Curved lines have been recognized in many aspects of earlier work, for example, in describing the circle at Section C level. In Section D the child may be led to a greater awareness of curved lines through drawing and describing them. For some children the discovery of various informal means to help them draw curved lines could be an interesting project.

Location

It is important that the child, having "explored" the classroom and the school-grounds, should continue to be encouraged to extend his environmental knowledge. This can be reflected in his ability to describe precisely, from memory, locations and routes within the school area that are significant to him. In earlier sections he had to find his way from one point to another, such as from his room to the office. Now he is asked to give directions so that another person can follow them :

> "Go out the door, turn left. When you get to the breezeway, turn right. The office is the first door on the left."

Because he is more responsible, the child now has greater freedom to move about in the community. He will see buildings, local landmarks, places of interest, and major roads. The teacher should help to satisfy his natural curiosity by identifying many of these places. The child is then able to add to his vocabulary in describing locations that are important in his environment :

> " Our school is between the hospital and the Nepean Highway."
>
> " There are magpies nesting in the tree opposite Miller's gate up near Five Ways."

Outcomes

By the end of Section D the child should be able to—

- (*a*) describe the location of prominent buildings and landmarks ;
- (*b*) relate models of shapes to objects in his environment, and appreciate relationships between objects and shapes that are almost true models ;
- (*c*) demonstrate some knowledge of ideas of bilateral symmetry ;
- (*d*) recognize and draw straight lines and curved lines.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section D, page 122.

Using circles and oblongs cut from card, make something that will stand by itself.

★

Write these three headings on your page :

OBLONG SHAPES CIRCULAR SHAPES TRIANGULAR SHAPES

Which of these shapes can you see in—

the house on the other side of the road ;
the shelter shed ;
the basketball court ;
the drinking taps ;
the clouds ?

Write this list under the correct headings.

You may make small drawings to show some of the shapes.

★

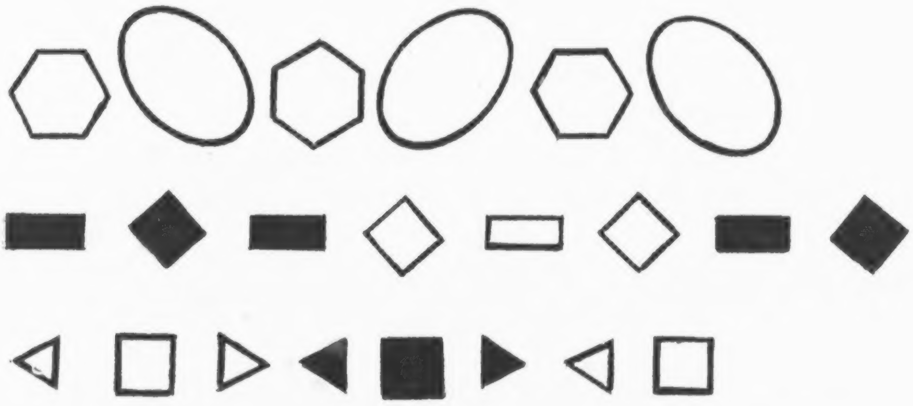
Note.—Pattern-making can serve three purposes :

- (i) To encourage the ability to predict ;
- (ii) to give opportunities to create a pleasant combination of shapes and, perhaps, colours ;
- (iii) to build up, through a repetitive process.

Unnecessary complications should be avoided. The greatest benefits will come from allowing the child freedom to make his own patterns and to devise his own " rules ", rather than from continually directing him.

A simple example of pattern-making is set out below.

Copy these patterns and continue them :



Now make a pattern of your own and ask a friend to continue it.

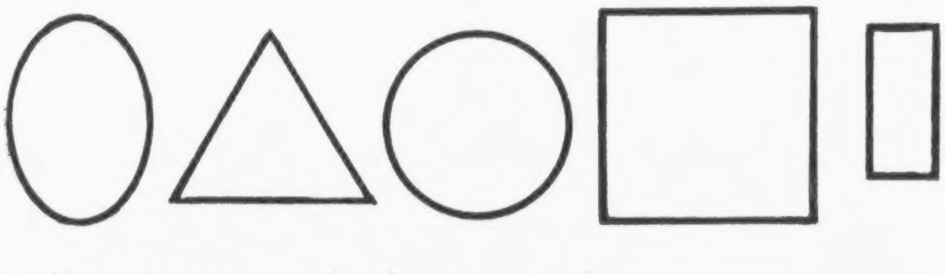
★

Rule lines in any direction on your paper. Colour in any triangular shapes you have made.

Use another colour to fill in any two shapes which will make a new triangular shape.

★

Draw a picture using as many of these shapes as you can :



Write the names of the shapes you used.

★

Rule six straight lines across your paper. Turn your paper and rule eight straight lines across your paper. Colour in all the oblong shapes you have made, using blue pencil. Colour in any squares with red pencil.

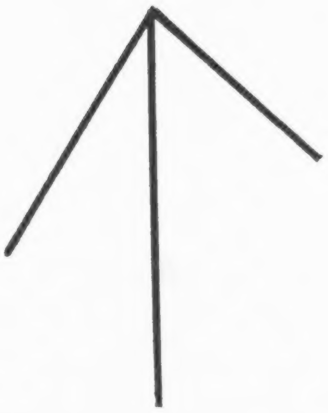
★

By adding lines to this drawing you can make triangles.

Can you rule one line to make one triangular shape on this drawing ?

Can you rule two lines to make two triangular shapes ?

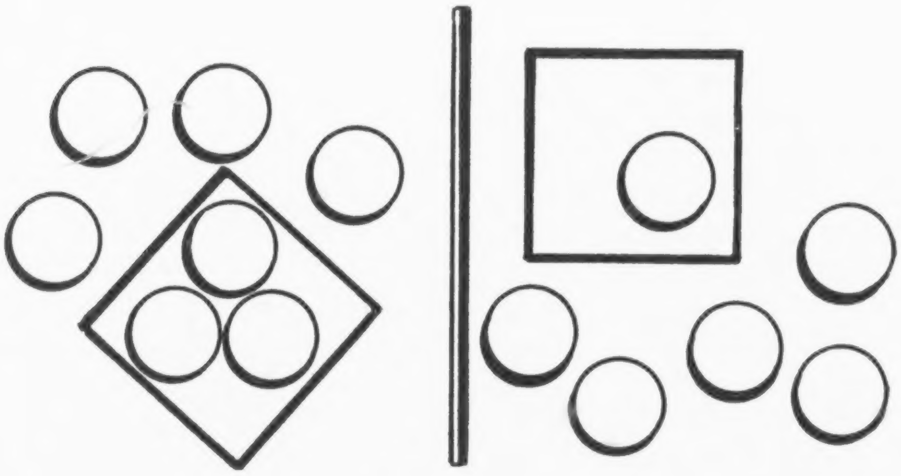
By ruling one line, what is the greatest number of triangular shapes you can make ?



Try to make up another drawing to start from, using four straight lines, and then see how many triangular shapes you can make by adding one or two more lines.

★

Look at the picture and then fill in the gaps in the sentences below.



There are ☐ counters inside the boxes.

There are ☐ counters outside the boxes.

There are ☐ counters above the boxes.

There are ☐ counters outside the box to the left of the stick.

Teachers can add other sentences to extend the activity, or the children can be asked to write their own.

★

Find a square piece of peg-board and some lengths of plastic string. Make the largest square shape you can by threading the string through the holes.

How many oblong shapes can you make inside this square ?

How many triangular shapes can you make inside each oblong ?

★

Using triangular shapes from the mosaic set, see how many different star shapes you can make.

★

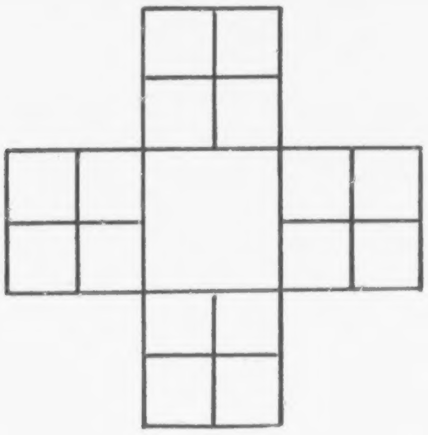
Make this shape from square tiles :

How many tiles did you use ?

How many square shapes can you see ?

What is the biggest square shape you can make using these tiles ?

What is the longest oblong shape you can make using all the tiles ?



★

Cut out :

two circular shapes ;
two square shapes ;
six oblong shapes ;
three triangular shapes.

Make a picture with these shapes. You may cut them if you wish.

★

Using the peg-board and golf tees make four square shapes. Fill all the holes in each shape with tees.

Now make three triangular shapes of three different sizes.

Make any other shapes you can.

SECTION E

INTRODUCTION

The broad principles of the course have been discussed in detail in the earlier sections of the Curriculum Guide, and teachers will have noted that the development of units of measurement has followed this sequence :

(*a*) *Informal units.* The child has been allowed to use any unit he considered appropriate, but a developing understanding of measurement has led him to see that the important applications of communication and comparison have demanded a common unit.

(*b*) *The introduction of the standard unit.* This was developed in two stages—the first stage allowed the child to become familiar with the unit ; the second stage gave the child practice in using the unit of measurement.

(*c*) *The division of the standard unit into equal parts.* Such work has been related to that of pure number where fractions have played their part, so that the child, on beginning Section E, can competently handle the half-pint, the one-third-pint, and the half-pound, and can tell the time using the half-hour.

It should also be noted that the work on money as planned in the course followed the child's pure number experiences so that he was not called upon to perform any transaction in the classroom shop or in his activities outside the range of his pure number knowledge.

In Section E, because of his increased maturity and greater manual dexterity as reflected in increased accuracy in his handling of the smaller units, the standard units are further divided and the child learns to handle the inch and the quarter-pound, and to read the time to five minutes. The work in volume and capacity centres on the consolidation of the work of Section D.

It is perhaps appropriate to stress again both the informality of approach to all aspects of the course and the important part played by discussion with the grade as a whole, as well as with groups and with individual children.

No involved recorded work, computation, or stress on formal definitions is required, and all solutions to problems should be discovered in a practical manner, using the method the *child* considers most appropriate.

Evaluation of the child's understanding and progress is a continuing process for the teacher. She should always seek situations she can use, not only to assist in gauging the child's understanding of the work that has been done, but also to provide problems that will allow the child to gain further understanding.

SECTION E—LENGTH

NOTES

This section consolidates the work of Section D, by providing further opportunities for the child to—

estimate and measure, using feet and inches ;

increase, through a wide range of activities, his skill in ruling lines, particularly of lengths which are multiples of the inch.

In this section the child's understanding is extended by allowing him to appreciate the need for a standard unit of length greater than the foot.

The Larger Unit

Reference was made in Section C (see the notes on Weight, page 83) to the aspect of convenience when a one-pound unit replaced a large number of smaller units such as beads. As the child appreciates the importance of the inch for measuring short lengths, so he is able to appreciate the convenience of the foot. If he is asked to measure a considerable length in feet he will come to realize the labour involved and can be encouraged to devise some means of making the task easier.

It is important throughout the course that the child appreciates that he can create for himself units of measurement. With respect to length he should understand that an unmarked length of wood, one foot long, will measure in feet as well as a one-foot ruler, but it is not suitable for measuring lengths less than twelve inches. Activities were introduced in Sections B and C to allow appreciation of this idea in length, weight, and capacity.

This principle may now be put to further practical use as the child is led to see that if he measures a four-foot length of wood and uses this as a standard of measurement he can—

speed up his measuring process ;

use this as a labour-saving device.

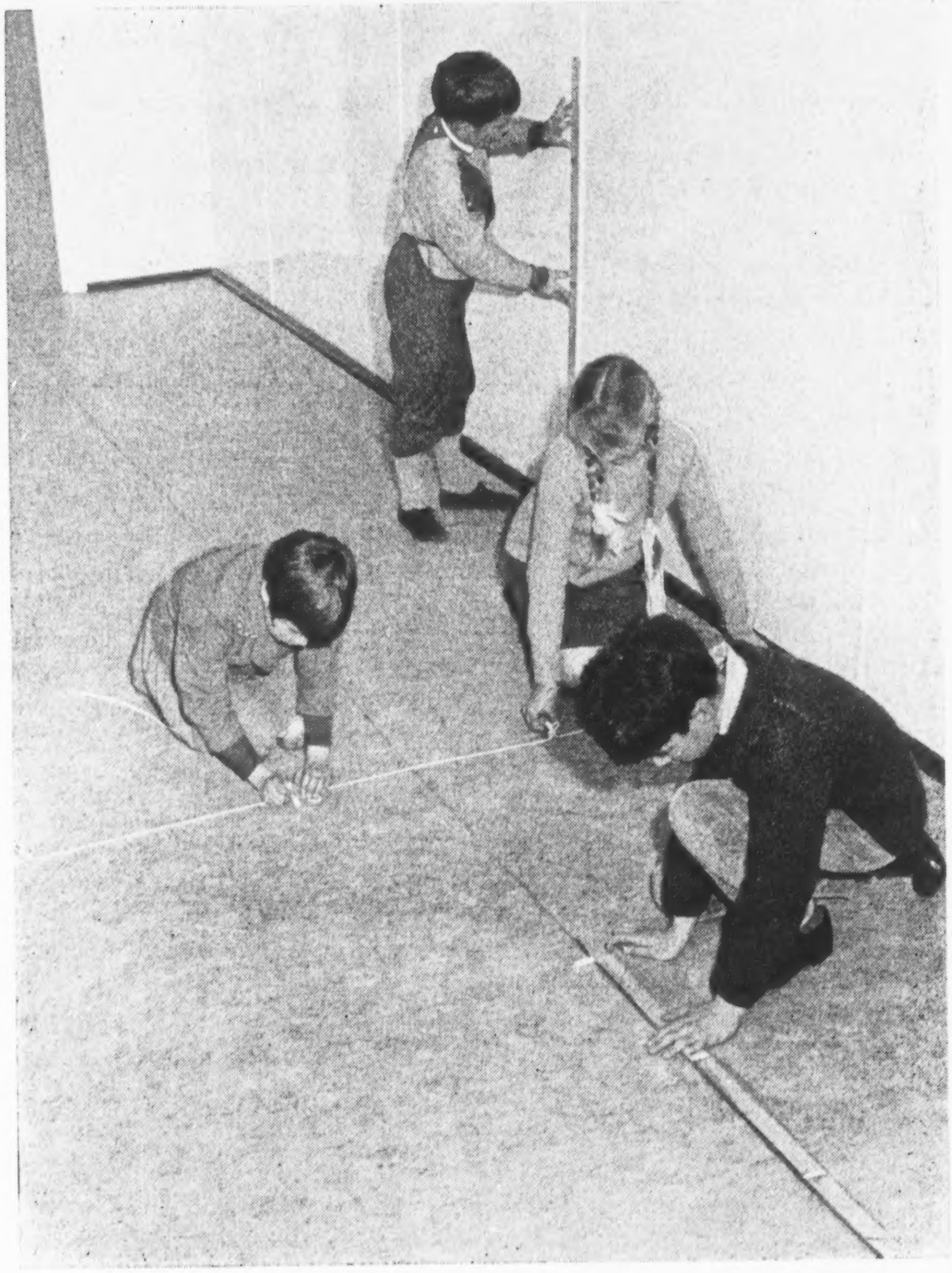
Teachers will appreciate that an important part of such an activity is the link with pure number, for the child is facilitating his measuring by utilizing group counting.

Further opportunities should be given to the child so that he can extend this principle to the use of knotted lengths of string or cord ; lengths of tape marked by pencil or crayon, or by tying on short lengths of wool at specified distances ; string or cord with bead markers ; or any other equipment he can devise for himself. The use of larger units calls for longer lengths to be measured, and the child should be given many opportunities to measure outside the classroom :

How far is the outside wall of our room from the fence ?

What is the distance between the shelter-shed and the gum-tree ?

How far apart are the wattle-trees in the front garden ?



Continuing Themes

Teachers should realize that throughout this section it is important for the child to continue activities commenced in earlier sections. These are :

The use of informal units. Appropriate informal units act as bases for comparison and reinforce the child's earlier and fundamental ideas of measurement. The children should be encouraged to use parts of the body, paces, hand-spans, and outstretched arms as informal units.

The choice of unit. The introduction of standard units of measurement should not inhibit the child from exercising a freedom of choice. However, he should be encouraged to use the appropriate standard units and to judge whether he should, for instance, use inches, feet, or a combination of both for the particular measuring he is doing.

Estimation. This is a developing skill which requires constant practice.

Matching and ordering. The theme of comparison is a basic idea in measurement and should be continually before the child.

Outcomes

By the end of Section E the child should—

(*a*) have gained in skill in ruling lines ;
(*b*) be able to measure accurately to one inch ;
(*c*) have realized the need for a unit longer than the foot ;
(*d*) continue to estimate and to check measurements ;
(*e*) confidently select and use appropriate units, both standard and informal.

SUGGESTED ACTIVITIES

Notes

As in earlier sections, these activities—

(i) are suggestions only, and are in no way prescriptive ;
(ii) may be used as a basis either for oral work or for assignment work ;
(iii) can provide the basis for work at varying levels or as part of a series of graded activities ;
(iv) are not complete in themselves but should be integrated with other examples in the overall development of the topic ;
(v) do not constitute a course.

Reference should also be made to the notes on the suggested activities for Length in each of the sections from A to D.

A careful reading of the activities will show that there is, in each case, an underlying purpose for the activity. They are not designed merely to provide " busy work " and to fill in time. Each activity undertaken by the child should consolidate or increase his knowledge and understanding and should allow him to apply some skill.

It should be stressed that discussion of activities between the teacher and the child, the group, or the class, or among the children themselves, is an integral part of each activity and should not be neglected.

In many of the examples presented, suggestions are given as to the manner of recording results. As the child gains in experience and confidence he should be encouraged to record his observations and results in his own manner. Often it is possible to construct an activity so that the child is directed both to the procedure and the form in which results are to be recorded, and then led to note any further observations in the form that he thinks is appropriate.

An example of an activity with different approaches to recording might be :

Rule a line two inches long.
Rule another line two inches longer than the first.
Rule a line two inches longer than the second line.
Keep going in this way.

Recording.—This can take the form of—

(*a*) Completion exercises, e.g.

My second line was ☐ inches long.
The longest line I could fit on my paper was ☐ inches long.

(*b*) Completion exercise with comparison, e.g.

Fill the gap with the words " longer than ", " shorter than ", or " the same as " :

My third line was ☐ my first line.
My second line was ☐ my third line.
If I joined my first and second lines together they would be ☐ my third line.

(*c*) Yes–no, true–false, or selection type answers—

The child is asked to indicate in some manner whether a sentence is correct or not, or to select the correct sentence from a number of suggestions.

(*d*) Presentation of results or observations by the child in his own way.

The child is asked to write a sentence about what he has done, or what he has found out, e.g.

" My longest line was twelve inches long."
" The last line I drew was ten inches longer than the first."
" I couldn't get a line bigger than twelve inches. My paper wasn't long enough."

The child may often be asked to provide an additional activity following on from what he has done, or be asked to prepare a question or a problem for a friend to attempt.

Activities

Provide many strips of material, such as card or wood, in 2-inch, 3-inch, 4-inch, and 6-inch lengths.

Match the strips.
Put them in order.
Guess their lengths.
Measure them.
Put all the smaller strips end to end in various ways to make six-inch lengths.

★

Fill the gaps by using the words "longer than", "shorter than", or "equal to". Guess first and then measure.

6 matchboxes, end to end, are ☐ one foot.
12 matchboxes, side by side, are ☐ one foot.

10 beads, end to end, are ☐ one foot.
6 beads, side by side, are ☐ one foot.

4 plastic sticks, end to end, are ☐ one foot.
12 plastic sticks, side by side, are ☐ one foot.

* * *

Find five things that you think are one inch long.

Rule a line five inches long.

Place your things along this line. Are they the same length, longer than, or shorter than the line? Why?

* * *

Using the material as above, this activity can be extended in a number of ways.

Put each of the equal lengths in pairs, end to end. Order these pairs from the shortest to the longest.

Add the second pair to the first pair, end to end.

How long is this new length? Does it equal any other length you have made?

Keep adding pairs and guessing the new lengths. How long is the last strip you made?

Can you add three equal lengths end to end so that they make the same length as two other strips?

* * *

Draw a line that you think is eleven inches long. Cover it with one-inch blocks.

Stack blocks on top of these to make a wall four inches high.

Measure the wall. Was it four inches high? Was it eleven inches long?

* * *

Make two dots anywhere on your paper. Try to make them four inches apart.

Rule a line to join the dots and measure it. How long was the line?

Now make two more dots about six inches apart. Rule and measure your line. Were you correct?

* * *

Take a birthday card from the box. Leave it closed. Guess the length of the longer edge. Guess the length of the shorter edge.

Measure. Were you correct ? Write down your guesses and the measurements.

Open the card out. Guess and write down the length of the longer edge. Guess and write down the length of the shorter edge.

Measure and tick the guesses that were correct.

★

Build a house from " bricos ". Make it four blocks long, three blocks wide, and six blocks high.

Guess the length ; guess the height ; and guess the width.

Measure in inches. Were you correct ?

★

Find lengths of cord which are one, two, three, and four feet long. Which of these would you use to measure—

the distance from the gate to the front door ;
the length of the breezeway ;
the width of the corridor ;
the length of your chalkboard ;
the distance between the locker and the cupboard ?

Estimate these lengths and then measure each one, using the unit you have chosen.

Did you use the best unit for each distance ?

Were your guesses correct ?

Can you think of a better way of measuring these distances ? Talk about it with your teacher or some of your friends.

★

Guess first and then measure in inches :

The length of—your shoe ;
a stick of chalk ;
a matchbox ;
your reader ;
your chalkboard.

★

Find four things longer than 1 foot.

Find three things longer than 2 feet.

Find one thing longer than 3 feet.

Put them in order, then guess the length of each one.

Now measure them and see how many times you guessed correctly.

★

If you could put the cupboard next to your table, how long would they be together ? Guess.

Measure. Were you correct ?

If you could put the library next to your table, how long would they be together ? Guess.

Measure. Were you correct ?

★

Provide strips of card, wood, lino, or similar material ranging in length from one to six inches.

Find two strips which are one inch different in length.

Join a one-inch strip to each. How much difference in length is there now ?

Join a two-inch strip to each. How much difference in length is there now ?

Add four more lengths to each. Find the difference in length each time.

What did you find out ?

Talk to your teacher about this.

★

Using a ruler, measure in inches—

your pencil ;
the longer edge of your chalkboard ;
your reader ;
a matchbox.

Write down each measurement.

Now measure—

your chalkboard and pencil together ;
your reader and pencil together.

Write down these measurements.

Can you guess the length of—

a matchbox and your reader together ;
a matchbox and the longer edge of your chalkboard together.

Measure and see if your guesses were correct.

★

Work out at least two ways of getting from the door of our room to the flag-pole.

Which would be the shorter way ? How long would it be ? How much shorter would it be ?

Choose a length of rope most suitable for measuring these distances. How long is the rope ?

Measure the distances. Were your guesses close ?

SECTION E—VOLUME AND CAPACITY

NOTES

In Section E the work of Section D is consolidated and opportunities are provided for the child to gain further experiences in the handling of problems in capacity.

Reference to the suggested activities listed for Sections D and E will indicate the progression in the two sections. Recording of results in brief form can be encouraged, and it is also of value for the child to record his estimations so that he can assess for himself his increasing skill.

Links with pure number are important throughout the course, and in this section many opportunities will be found for integration of the work on fractions with concrete situations developed in the applied number work :

How many bottles of milk are there in this crate ?
How much does one bottle contain ?
How much should all the bottles contain ?

The classroom shop may also be used as part of the activity work just as it was used for work with weight. The relating of work on money and capacity provides a new interest for the child.

Outcomes

By the end of Section E the child should—

(*a*) be able to apply the ideas of Section D with greater confidence and understanding ;
(*b*) have increased his skill in estimation.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section E, page 149.

By using one-pint, one-half-pint, and one-third-pint bottles, and a variety of containers, many activities can be created :

Which bottle would you use to measure the contents of :

the jug
the bowl
the kettle
the beach bucket
the saucepan
the little jar
the mug
the cup
the basin ?

★

Find four jars of different shapes. Pour what you think is half a pint of water into each one. How many of these should fill the one-pint jug ? Measure. Were you correct ? How much water altogether should there be in the four jars ? Measure. Were you right ?

★

43

Put one pint of water in the jug. Find two jars of the same size which will just hold this water when they are both full.

Measure. Were you correct ? How much water is in each jar ?

Put another pint of water in the jug. Now find three jars, each of the same size, which will just hold all this water when they are all filled.

Measure. Were you correct ? How much water is in each jar ?

★

Find three jars, each of the same size, which you think will hold one pint altogether. Fill them. Now measure. Did you guess correctly ? How much does each jar hold ?

How many of these jars would you need for two pints ? How many would you need to measure—three pints ?
four pints ?

Guess, then measure.

★

Put one pint of water into the jug. Get three cups and pour what you think is an equal amount into each cup until the jug is empty. How much should be in each cup ? Measure. Were you correct ?

Put one pint of water into the jug again. Find three jars o different shapes. Pour what you think is an equal amount of water into each jar until the jug is empty. How much water should be in each jar ? Measure. Were you correct ?

Talk to your teacher about the things you did.

★

Find six containers that are more than six inches tall. They must be of different shapes.

Put them in order from the one that holds the least to the one that holds the most.

Check to see if you are correct by filling them with water and measuring. Were they in the correct order ?

★

How many pints fill—
the bucket ?
the jug ?
the big jar ?

Guess first and then measure.

Now guess how many half-pints would fill each container. Measure.

Were you correct ? Talk to your teacher about your answers.

★

Provide containers holding one, two, three, and six pints, and a four-pint billy-can.

How much do you think each container holds ? Check by measuring. Write down the amounts. Tip out the water.

Work out different ways of putting four pints of water into the billy-can, using the smaller containers. Write down each way.

Find different ways of filling a five-pint container.

★

The billy-can holds four pints. Tip water into it until you think it is half full. How much water do you think this should be ?

Now measure and see if you were right.

Find other containers, half fill them after you have guessed how much they hold, and then measure to see if you were correct.

★

Find two identical containers that each hold more than two pints.

Pour one pint into each.

Now pour one half-pint into each.

How much water do the containers hold altogether ? What do you know about the amount in each container ?

Now pour one half-pint into the first container. Pour water into the second container till the water levels are the same in each one.

How much water is in the first container ? How much water is in the second container ?

Talk about what you did and what you discovered with your teacher.

★

Make up an activity like the one above, taking water out of two containers.

★

Using the School Milk Situation

Note.—It is important to know the contents of containers being used, particularly in exercises or discussions such as these. Teachers should check to see where the water level comes in all containers holding stated amounts. For example, does a milk bottle hold a full pint of milk when the level comes at the lip, at the top of the bottle, or at a line or mark near the top of the bottle ?

Suggested themes for discussion are :

How many bottles does the crate hold ?
How much milk should each bottle contain ?
How many pints are there in all the bottles ?

Partially filled crate :
    How many bottles are in the crate ?
    How many pints are there ?
        (Notice the link with pure number in counting the
            bottles : $5 + 5 + 5 + 5 + 5 + 5$;
            $6 + 6 + 6 + 6 + 6$;
            5 times 6 ; six times five ; etc.)

How many boys have milk to drink ?
How many girls have milk to drink ?
How much milk do the boys drink ?
How much milk do the girls drink ?
Are there more boys or more girls who drink milk ?
How many more ? How many more pints do they drink ?

How many bottles have not been used ?
How many pints in these bottles ?

How many rows of bottles are in the crate ?
Are the numbers in each row equal or unequal ?
How many pints in each row ?
When you have removed one bottle from each row, are the numbers in the rows equal or unequal ?
How many bottles are left in each row ?

When you have removed two bottles from each row—
    how many bottles are left altogether ?
    how many bottles are left in each row ?

Use one straw for each bottle :
    When you have used three straws how many pints are ready for drinking ?
    When you have used twelve straws how many pints are ready for drinking ?
    How many straws will be needed for two pints ; for four pints ; for eight pints ?
    How many straws will be needed for a crate filled with bottles ?
    How many pints are in the full crate ?
    How many straws will be needed for half a crateful of bottles ?

SECTION E–WEIGHT

NOTES

The Quarter-pound

It should soon be evident to the child that in spite of halving the pound there are many objects to be weighed which are still "a bit over" or "a bit less" in weight than one of his formal units. Just as he was encouraged to discover and use the half-pound, so the child should be allowed to discover the use of the quarter-pound. Again this work should be related to that of fractions in pure number.

By suitably planned activities the child should be—

(i) led to discover the quarter-pound ;
(ii) allowed to find as many things as possible weighing one-quarter of a pound.

From these activities the child should gain further appreciation of basic ideas concerning the dividing and the combining of quantities. All this work may be consolidated through shopping experiences.

Some children may discover the relationship between the fractional parts of the pound they are using. They may also come to realize that the container and contents that weigh a quarter-pound can be used as a unit of measurement as readily as can the standard metal quarter-pound weight.

Discussion centred on the symbol "lb." may lead to the story of the symbol.

Continuing Themes

Aspects of the course which were developed in earlier sections should continue to be presented to the child through activities and oral work. Some of these are :

(i) Estimating and checking results ;
(ii) the continued use of both informal and standard units ;
(iii) the idea that size is not a certain indicator of weight, that it is at least necessary to pick up an object to gauge its weight ;
(iv) comparison, matching, and ordering ;
(v) the use of the balance—a weight added to or taken from one pan requires that an equal weight be added to or taken from the other pan to maintain balance ;
(vi) the choice of appropriate units.

Outcomes

By the end of Section E the child should—

(*a*) be able to weigh accurately using the quarter-pound, the half-pound, and the one-pound weights, both standard and informal ;
(*b*) have increased his skill in estimation and be able to find by estimation articles weighing approximately one pound.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section E, page 149.

Provide several pairs of one-pound, half-pound, and quarter-pound bags of material.

Find the pairs of bags of equal weight.

Place one of each pair in one pan, and the other in the second pan of the balance.

What do you know about the weight ?

Remove one pair. What happens to the balance ?

Remove another pair. What happens to the balance ?

Keep removing pairs until there is only one pair left. What happened to the balance each time ?

Talk to your teacher about what happened and why.

★

Weigh ¼ lb. of rice. Will it fit into a cup ? Guess first and then try.

Which of these do you think will fit into a cup ? Write *Yes* or *No* beside each one and then check using the balance.

¼ lb. of nails ☐
¼ lb. of marbles ☐
¼ lb. of stones ☐
¼ lb. of beads ☐
¼ lb. of chalk ☐
¼ lb. of cotton wool ☐

★

Find four large things that each weigh less than ¼ lb.

Find six smaller things that each weigh more than ¼ lb.

Find two things, of any size, that each weigh ¼ lb.

Guess first and then check. Were you correct ?

★

Fill the gaps with " more than ", " less than ", or " the same as " :

1 lb. of shells weighs ☐ a cupful of sawdust.
½ lb. of counters weighs ☐ a cupful of sand.
¼ lb. of stones weighs ☐ a cupful of nails.
1 lb. of beads weighs ☐ a cupful of bolts.

After you have guessed, check on the balance.

Were you correct ?

★

If you had a 1-lb., a ½-lb., and a ¼-lb. weight, which would you use to weigh :

a big block ;
a jar of sand ;
eight marbles ;
two bolts ;
a cupful of beads ;
a handful of stones ;
a jarful of chalk ;
a chalk-box full of sawdust ?

Weigh them. Were you correct ?

★

Weigh out one half-pound of sand. Now tip the sand into two bags so that each will weigh the same.

How much does each bag weigh ?

Take another half-pound bag of sand and divide it in the same way.

If you weigh the four bags of sand in one pan against a one-pound weight, what would you expect to happen ?

Try it to see if you guessed correctly.

Talk to your teacher and tell her why this happened.

★

Guess first, then weigh, and fill in the gaps :

○ blocks weigh 1 lb. ;
○ marbles weigh 1 lb. ;
○ bolts weigh 1 lb. ;
○ cupfuls of rice weigh 1 lb.

What will the blocks and the rice weigh altogether ?

What will the marbles and the bolts weigh altogether ?

Double the number of marbles. What do they weigh ?

Double the number of bolts. What do they weigh ?

Halve the number of blocks. What do they weigh ?

Discuss what you have discovered with your teacher.

★

Provide tins containing a variety of materials for weighing and a number of plastic bags.

Weigh ¼ lb. of each of the materials on the table.

Put each ¼ lb. into a separate bag.

How many of these bags would you need to weigh these things ?

½ lb. of rice ☐
¼ lb. of shells ☐
1 lb. of nuts ☐
¾ lb. of wheat ☐
2 lb. of water ☐

Guess first and then check on the balance. Tick the answers that were correct.

★

Provide bags of material weighing a quarter-pound, a half-pound, and one pound.

Fill the gaps with "more than", "less than", or "the same as". Guess first and then measure :

Three ¼-lb. bags will weigh ☐ 1 lb.
Five ½-lb. bags will weigh ☐ 2 lb.
Three 1-lb. bags will weigh ☐ six ½-lb. bags.
Two 1-lb. bags will weigh ☐ eight ¼-lb. bags.

★

Guess first and then check on the balance :

Four ½-lb. bags will weigh ○ lb.
Three ¼-lb. bags will weigh ○ lb.
Two 1-lb. bags will weigh ○ lb.
Two 2-lb. bags will weigh ○ lb.

★

Put a ¼-lb. weight in one pan and put rice in the other until the balance is level. What do you know about the weight of the rice ?

Add another ¼-lb. weight to the first weight. Add more rice until the balance is level.

How much does each side weigh ? How much rice did you add ?

Keep adding quarter-pound weights and balancing with rice until each side weighs one pound.

How many quarter-pound weights did you use ?

★

Weigh out four ¼-lb. bags of wheat, four ¼-lb. bags of shells, and four ¼-lb. bags of gum nuts. Tick the sentences you think are true and then check, using the balance :

I have weighed less than 1 lb. of wheat. ○
I have weighed more than 2 lb. of shells. ○
My four bags of wheat weigh the same as my four bags of gum nuts. ○
Three bags of wheat weigh less than three bags of shells. ○

★

Provide a variety of materials such as beans, stones, sand, marbles. a one-pound weight, and plastic bags.

Weigh one pound of each of the four materials.

Halve each pound. Guess first and then check to make sure that the parts balance. How much is in each bag now ?

Halve each bag. Guess first and then check to make sure the parts balance. How much is in each bag now ?

Fill the gaps and then check to see if your guesses were correct :

I have △ ¼-lb. bags of sand.
I have △ ¼-lb. bags of marbles.
△ ¼-lb. bags of stones weigh the same as ½ lb. of stones.
△ ¼-lb. bags of beans weigh the same as ½ lb. of beans.
△ ¼-lb. bags of stones weigh the same as ½ lb. of sand.
△ ¼-lb. bags of marbles weigh the same as ½ lb. of beans.

SECTION E–TIME

NOTES

The work of Section E is basically a refinement of that begun in Section D, for the child is led—

(*a*) to use smaller units to tell the time—the quarter-hour and the five-minute interval ;

((*b*) to begin to name the months in sequence ;

(*c*) to become aware of a smaller unit of time—the minute.

In this section, much enrichment work connected with time can be introduced—the simple pendulum, the metronome, and varieties of clocks such as the grandfather clock and the pocket-watch.

The rhythm of the ticking of a clock may be allied to ideas of rhythms in songs and records, thus assisting the child to appreciate the regularity of each time span.

A greater interest in the duration of time, shown through comment and by observation, will help understanding of how events relate to the continuity of measured time. For example :

"This record plays for twenty-five minutes."

"The telecast lasted twenty minutes."

The Quarter-hour

When the child can confidently read the time and record the time in half-hours and show this on the clock-face, the quarter-hour may be introduced. Integration with work in pure number dealing with fractions will allow the child to appreciate more readily that the quarter-hour is a smaller part of the hour and that there are four such equal parts in the hour. Both the relationships and the vocabulary arising from the relationships should be fully understood.

The position of both the large and the small hands of the clock should be carefully noted. Not only should the child show in discussion his awareness of the movement of the hands, but his understanding should be reflected in careful, fairly accurate assignment work.

Although the clock-face positions of "quarter past" and "half (or two quarters) past" are grasped fairly readily, the "quarter to" position often poses a problem, and much practice may be needed to establish this position with understanding. Thus, work with "quarter past" should be well consolidated before "quarter to" is introduced. Some activities based upon counting around the clock by fives can be helpful, and clock-faces shaded in halves may assist in giving the child some visual representation.

Five-minute Intervals

When the child is competent at using the quarter-hour, the shorter interval of five minutes may be introduced. Abilities of children to tell the time with the smaller unit of measurement vary greatly. Some require little practice before they become quite confident, while others experience difficulty.

A prerequisite to the confident use of the five-minute interval is the ability to count by fives and, from this, to relate the numbers on the clock-face to multiples of five. A further difficulty arises with the words " past " and " to ", particularly in establishing the position of the minute hand at 7 as " 25 minutes to " and at 8 as " 20 minutes to ".

The Minute

From discussion of the five-minute interval, the minute as a unit of measurement of time can be introduced. The child will have heard of the minute through colloquial speech :

" Wait a minute."

" I'll be there in a minute."

Because the child uses such expressions it should not be inferred that he means anything more than " in a little while ". In Section E he can be made aware of the minute by using the sweep hand of a clock, a stop-watch, egg-timers, and similar equipment adjusted to measure this length of time. Some occasional estimations may have value, but no great degree of accuracy should be expected.

The Months

In this section the child should know the names of all the months and be able to put some of them in sequence. For example, it is possible to link " this month " with " last month " and, later on, " this month " and " next month ". Special festivals highlight some months, thus adding meaning to the time.

Writing of the date will continue as a daily activity. This may be varied—

Wednesday, Nov. 16 ;
November 16 ;
16th November 1968 ;

and teachers will need to select the form they feel most appropriate for the child and his level of understanding.

Outcomes

By the end of Section E the child should—

(a) tell the time to five minutes ; that is, the large hand should point directly to one of the numerals on the clock-face when the child is asked to tell the time ;

(b) name the months of the year, not necessarily in sequence ;

(c) read and write the date ;

(d) be aware of the minute as a unit of time.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section E, page 149.

Use a calendar.

What is the date of the last day of this month ?

What is the date of the first day of this month ?

How many days are there in this month altogether ?

What is the name and the date of the day before the 15th ?

What is the name and the date of the day that comes between the 3rd and the 5th ?

★

Use a calendar. Begin at January and find the names of—

the first month ;
the third month ;
the eighth month ;
the tenth month ;
the sixth month ;
the ninth month.

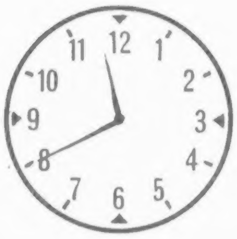
Which of these months have the most days in them ?

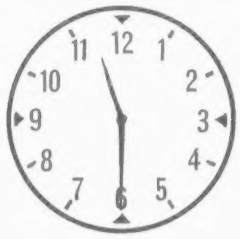
Which of these months have the fewest days in them ?

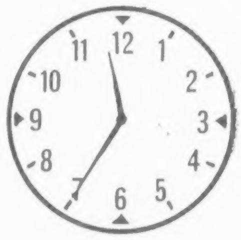
★

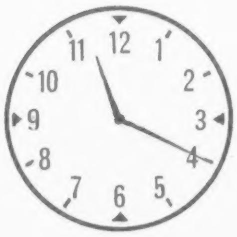
Prepared cards can be provided.

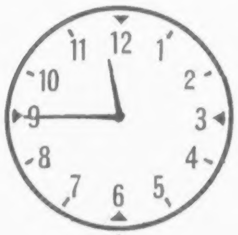
Put these times in order, beginning with the earliest. Then write the time for each in words.

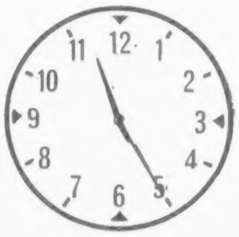












★

Provide prepared cards. Small cards may be used to "fill the gaps".

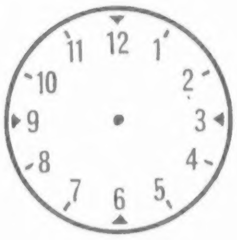
I know three children named John, Sharon, and Geoffrey. They all live in the same house and go to the same school.

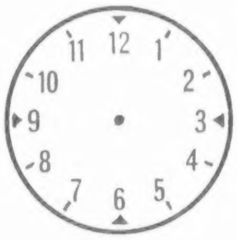
John came to school on his bicycle, Sharon walked to school, and Geoffrey was driven to school in the car. They all left the house at the same time.

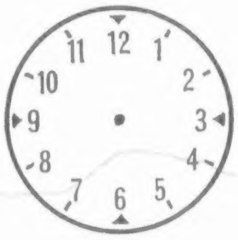
Choose from the times below the length of time you think each child took to come to school. Write the names in the spaces :

twenty minutes ☐
ten minutes ☐
five minutes ☐

If they left at eight o'clock, draw in the time each arrived at school :







* * *

A child is asked to set the play clock at the time when he predicts an event will take place, for example : "Everyone will have finished his painting by 2.30."

The hands remain in position until the prediction can be checked.

* * *

Write down a time between half-past and o'clock which comes—

after midday ;
during the afternoon ;
in the morning ;
before midnight.

SECTION E—MONEY

NOTES

During Section E the work of the earlier sections is consolidated so that, as the child begins Section F, he can confidently work within the wider money range to one dollar.

In Section E, the background of number knowledge he has acquired, especially in the range 1–20, allows him to work freely and gives him confidence to explore, on his own initiative, money relations outside this range.

Equivalent Values

In the earlier stages of his work on equivalent values, the child was presented with simple amounts to be made up to a stated value in any way he chose. In Section E this work continues, and during these undirected activities the child should continue to use substitution, replacing some, or all, of his selected coins with others of equivalent value. The practical advantages of such a skill can be demonstrated as the child gives and receives change in the classroom shop and comes to realize that many one-cent coins may be less convenient to carry than a mixture of coins.

Much experience will be needed to develop the idea of making coins up to stated amounts in the most convenient manner, and activities should be devised to implement this.

In Section D the fifty-cent coin was introduced, and in Section E the dollar and its symbol are recognized. In neither case is work on equivalent value extended to this range.

Shopping

Although the shopping limit is still set at transactions up to twenty cents, change may be given either to ten or to twenty cents. The child can buy more than one article, provided the total cost does not exceed ten cents.

These limitations keep the shopping activities within the range of the pure number work of Section D, and the child is given further opportunities to consolidate his number work.

Examples of the types of transactions that may be carried out are :

Buy one book at 15c.
    The child tenders 20c and receives 5c change.
Buy one pencil at 3c and one ruler at 4c.
    The child may (i) tender 7c ;
        (ii) tender four 2c coins or a total of 8c ;
        (iii) tender a 10c coin ;
    and receive the appropriate change.
Buy two books at 5c each.
    The child may (i) tender the exact money ;
        (ii) tender a 20c coin and receive 10c change.

It should be noted that, to some children, the handling of money outside the classroom is an established practice and, with sufficient number knowledge, they can readily move through the stages of the course. For other children, most of their knowledge and experience will come from the classroom ; therefore it is essential that opportunities to gain understanding should be given to them through graded, directed activities.

As has been indicated in the notes on weight and capacity, variety can be added to the activities of the shop by the addition of suitable materials to allow the pound, the pint, and the units derived from these to be used.

Outcomes

By the end of Section E the child should be able to—

- (*a*) buy and sell objects involving simple change with a limit of twenty cents ;
- (*b*) recognize coins and notes to one dollar ;
- (*c*) set out stated amounts of money in a convenient manner.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section E, page 149.

Put a line under the answer you think is correct :

Which will buy the most—

a dollar ;
five cents ;
fifty cents ?

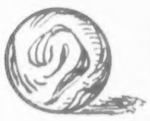
Which could you buy with 5 cents—

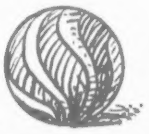
a bicycle ;
a football ;
an ice-cream ?

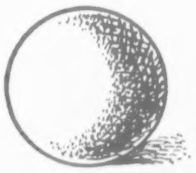
Which could you buy with one dollar—

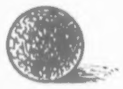
a book ;
a car ;
a house ?

Which marble costs the most ?


7c


5c

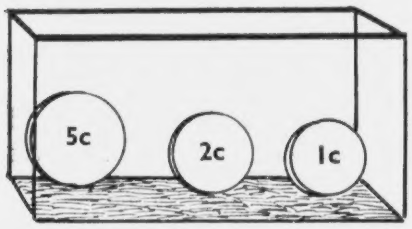

2c

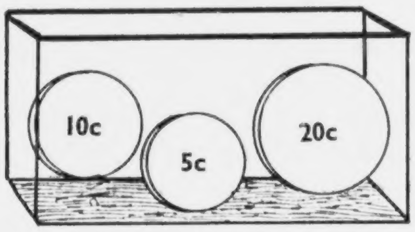

1c

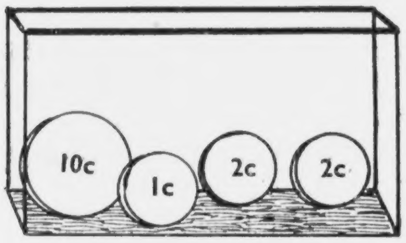
Put a tick beside the marble that costs the least.

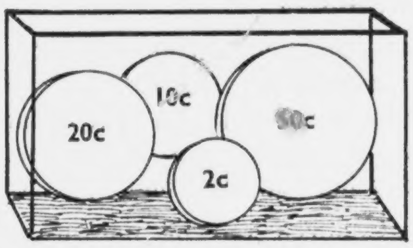
★

Write down how much money there is in each box altogether :









Put these amounts out in order from the most to the least.

★

Select coins to the value of 50c in as many different ways as you can.

If you have time, write down how you made up each of the sets of fifty cents.

★

Make five cents in as many ways as you can.

Make fifty cents the quickest way you can.

Find as many ways as you can to make ten cents.

Write down, as an equation, each way you made ten cents.

★

Put out 20c using—

two coins that are the same ;
ten coins that are the same ;
twenty coins that are the same ;
four coins that are the same.

Now put out 20c using coins of different values—

2 coins of ☐ and one coin of ☐ value ;
5 coins of ☐ and one coin of ☐ value ;
5 coins of ☐ and two coins of ☐ value.

Make up some other combinations and ask your friend to work them out.

SECTION E—SPATIAL RELATIONS

NOTES

The topics of earlier sections provide sufficient basis for the child to continue the informal exploration and discovery of relationships between shapes in Section E.

Symmetry

Symmetry, introduced in Section D, lends itself particularly to this informal approach, and the child should discover many ways of using symmetry creatively in the making of designs and patterns. Observation can be encouraged as he looks for symmetry in nature, buildings, household articles, and, in fact, in the world about him.

Children can be encouraged to collect examples of symmetrical leaves and flowers, or perhaps they may make a booklet dealing with symmetry.

Location

The child is now quite independent and is beginning to accept some responsibility for the well-being of others. He should therefore be able to give simple directions to guide others to nearby shops, landmarks, and other places in the local area. He should also be able to describe accurately the route he usually takes between home and school, as well as alternative routes.

Shapes

Long familiar with two-dimensional shapes, and interested in finding similar shapes in the world about him, the child can now focus his attention on the third dimension. Discussions based on the feel of three-dimensional objects, the space they occupy, and suitable shapes to contain them, all provide a foundation for an appreciation of the third dimension. Activities initiated in work on volume and capacity provide a further widening of experience.

The matching and comparing of shapes will provide opportunities for simple, informal classification and will assist in drawing the child's attention to likenesses and differences. Links with science can be established because the child can informally investigate such topics as the stability of certain shapes.

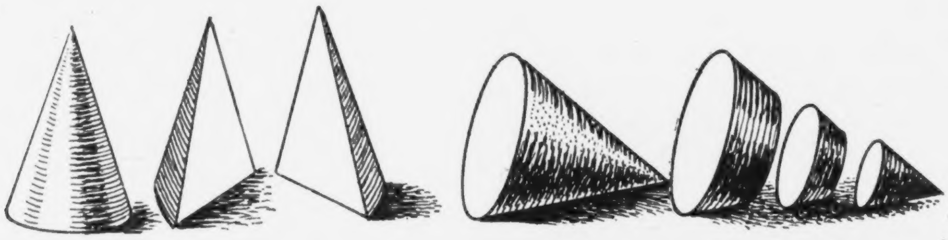
> Towers could be built, first using large cubes and then using small cubes. Which tower has the more cubes ? Which tower was easier to build ? Why ?
>
> The rolling of certain shapes could also be compared, particularly in relation to the behaviour of the cylinder, the cone, and the sphere.

Other topics will suggest themselves to both teachers and children as situations develop from activities.

As the child becomes familiar with these shapes and is able to model them from clay or dough, many activities can be introduced relating to two-dimensional and three-dimensional shapes :

> Make a cylinder from clay. Lay it on the table and cut it into slices. What shape are the slices ? Are they all of the same size ? Are they all of the same shape ? Can you make another cylinder and cut it to give slices of a different shape ?

Similar activities can be devised where the child relates the shapes of surfaces made by cutting three-dimensional figures to the two-dimensional shapes he knows.



It should be stressed that in all cases the approach should be informal and no attempt should be made to define in geometrical terms. The experiences of " doing " and " seeing ", together with discussion, are enough to provide at this stage a growing understanding of the relationships the child is investigating.

Teachers will also be aware that the child will need assistance in forming his ideas of " surface ". Simple introductory activities, using variously textured materials, linked with appropriate discussion will allow the child to gain the experience needed for understanding.

A simple activity could be to provide two pieces of textured material, such as velvet, ask the child to close his eyes, and then say—

> " Feel this piece of material on the table in front of you. Feel how long it is, how wide it is."
>
> " Find the edge. Run your finger along the edge. Put your hand flat on the material. Is your hand larger or smaller than the material ? "
>
> " Here are two pieces of velvet. Find, by feeling, which is the larger piece."

Once the idea of a surface has been established, the child will then be able to talk about the shapes of new surfaces produced by cutting three-dimensional shapes, as discussed above. The surfaces of rectangular prisms, cones, cylinders, and spheres can all become topics for discovery and discussion.

In the same way as the child was given opportunities to join two-dimensional shapes to make new shapes, so he should join three-dimensional shapes. The results of these activities may be the synthesis of—

further formal shapes, such as two cubes to make a rectangular prism ;

informal shapes, which may be pleasing in appearance but which neither have a specific name nor can be identified with any known object ;

informal shapes, which can be identified with the environment, such as a pyramid and a rectangular prism to make a "house".

Once the child has developed the skill to make shapes from clay or dough, he may be encouraged to cut his shapes and synthesize further models.

Lines

The work of Section D, which centred on straight lines and curved lines, may, in Section E, be extended to include the recognition of vertical lines and horizontal lines.

It is stressed that this work must be related to the environment. Although common language usage may condone the expression "Draw a vertical line on your page", it should be recognized that this is an impossible task unless the page itself stands vertically. Both horizontal lines and vertical lines may be drawn on the chalkboard fixed to the wall. Confusion may arise when translation to the horizontal page occurs, and it is important that at this stage the child be asked to isolate and recognize horizontal lines and vertical lines which are truly so, are in the environment, and are not conventional representations of these lines.

Outcomes

By the end of Section E the child should—

(*a*) be able to recognize, though not formally define, certain three-dimensional shapes—the cone, the cylinder, the sphere, and regular solids ;

(*b*) have widened his appreciation of shapes in his environment ;

(*c*) be able to identify vertical lines and horizontal lines in his environment.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Section E, page 149.

If your feet were wet and you walked across the floor, you would leave footprints.

Draw a line of footprints across your paper.

Draw a line of sparrow's footprints across the paper.

Draw a line of dog's footprints across the paper.

Draw a line of any other footprints you know.

★

Stand behind your chair so that you are facing the windows. Turn right and walk as far as you can. Which way must you now turn to reach the big cupboard ? How many more turns do you have to make ?

★

Stand at the door. Work out two ways of getting to the front gate—one way by turning left at the door ; the other way by turning right at the door.

Which is the shorter way ?

Estimate the distances and measure by counting paces.

★

A grid can be drawn on the ground and the children themselves move on it for this exercise. An alternative is to provide a squared board and to allow the children to move counters so that a game is constructed. The chalkboard or squared paper may also be used. The last part of the exercise will need to be adapted according to the method used.

				HOME
START				

You are allowed to move in these four directions only—

→ ← ↑ ↓

How many different paths can you take to get from START to HOME ?

How many squares do you land on for each route ?

(Colour in the squares used for your shortest route.)

(Put a cross in the squares used for your shortest route.)

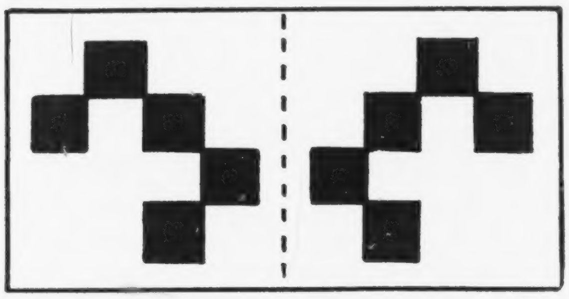
(Place a counter on each of the squares of your shortest route.)

★

Fold and cut a square of coloured paper into smaller squares.

Fold a larger piece of white paper in half.

Paste the coloured squares on to the white paper to make a picture that balances like this one.

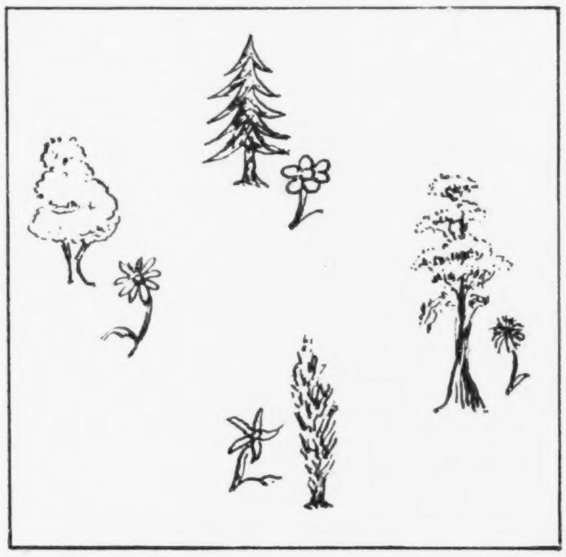


★

Using oval shapes and diamond shapes, make a picture of a strange animal with a fierce expression.

★

Using a ruler and a pencil, divide this square into four parts, each part containing one tree and one flower.



Can you divide it so that each part is the same shape as the other parts ?

★

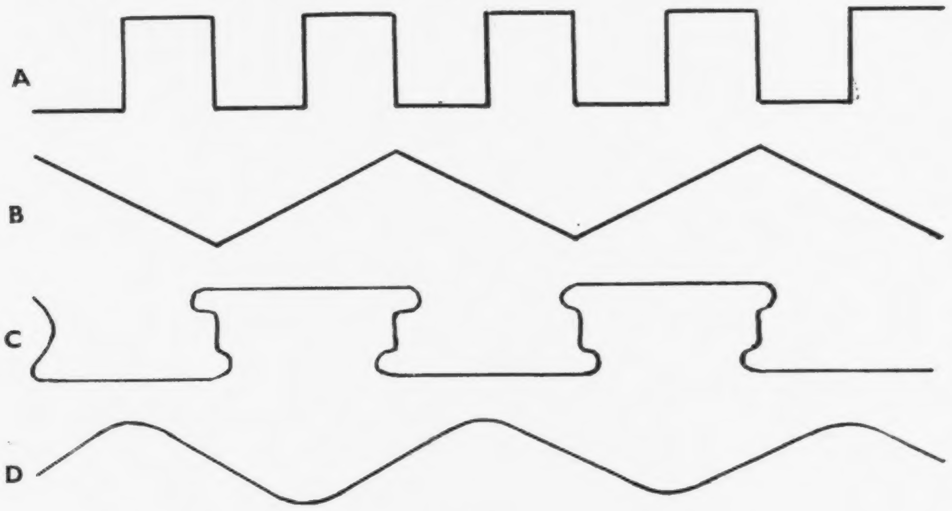
Draw two columns. Use these headings :

CIRCULAR SHAPES OBLONG SHAPES

Think of all the parts of a car you could put under each heading.

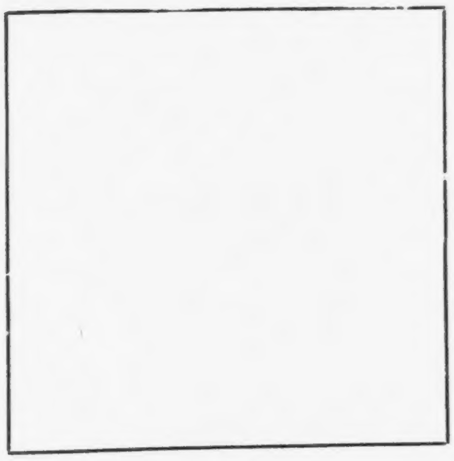
★

Measure each of these lines with a piece of string or cotton.
Which line is longest ? Which line is shortest ?
Write the order from the longest to the shortest.



★

Find all the triangles in the set of mosaics (supplied).
How many of them do you need to cover this square completely ?



★

Work with a partner.

Take three squares of coloured paper, each of a different colour. Cut each square into four pieces of different shapes.

Your partner takes three squares of coloured paper, each one different from yours, and does the same.

Change your papers with your partner.

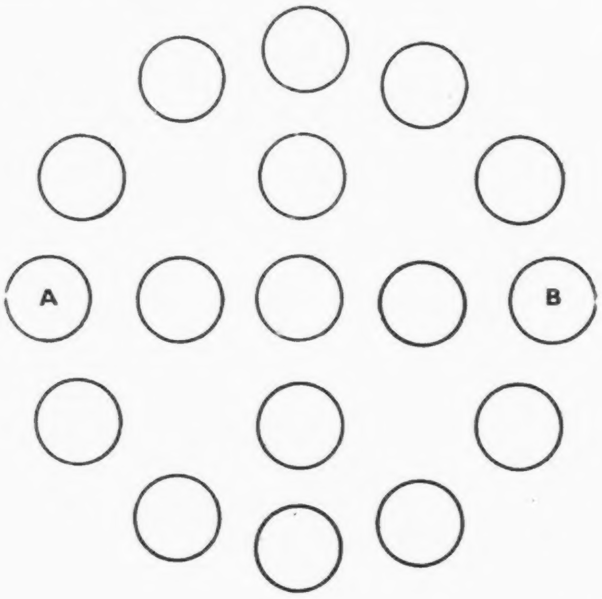
He has to put your squares together; you have to put his together.

See who finishes first.

(This exercise may be adapted to let each child use three paper squares, all of the same colour.)

★

Arrange hoops in this way :



Work with a partner. You start at A and have to get to B, one jump in a hoop. At the same time your partner starts at B and has to get to A, one jump in a hoop. In any turn you must not use a hoop that your partner has used. How many different ways can you work out to do this ?

★

Take a sheet of brown paper and fold it in half. Take off your shoes. Draw around your left shoe on the left half of the paper, and your right shoe on the right half.

Are both shoes exactly the same ? Stand a mirror on the fold line, so that you can see your left shoe print in the mirror. Does it still look like a left shoe ?

Now turn the mirror round and look at your right shoe print. What does it look like ?

Get another sheet of paper and fold it in half. Spread your fingers and draw round your hands. Look at each one in the mirror. What do you notice about each hand print ?

★

From the blocks (supplied) take—

2 large triangular shapes, 2 small triangular shapes, 1 square shape, and 4 oblong shapes.

See how many different shapes you can make using all the blocks each time.

Draw around each completed shape. Can you give any of them a name ?

SECTION F

INTRODUCTION

Teachers should appreciate that the course in applied number must, of necessity, be closely integrated with that of pure number, for both are aspects of mathematics as a whole. The course in mathematics has been planned around the development of the child's vocabulary, knowledge, and skills, as well as his growth in experience. Thus it would be completely wrong to consider each section of the course as one of a series of units of work.

As the child progresses in his mathematical growth so he grows in maturity. From Section A to Section E the child has been gaining confidence, experience, knowledge, and skill.

In Section F, because of his maturity, he reaches a stage where he can apply this knowledge, use his experience, and develop techniques in a much wider field and with a greater degree of freedom.

He is able to record his findings without undue effort, because of his competence in reading and writing, and can, at times, show a fair degree of originality in discovering solutions to his problems. He becomes less dependent upon teacher directions and responds to encouragement and suggestion when he feels he needs it.

It will take time for this confidence to develop fully, and it may not be until the latter half of the period he spends in Section F that it is seen at its highest peak.

The formal units of length, capacity, and weight, which he will use in Section F, are extensions of ideas that have been presented before. The yard and the gallon are multiples of standard units with which the child is familiar, and they demonstrate the idea of convenience. The ounce is part of a familiar unit, and its use demonstrates the idea of greater accuracy developing from smaller units of measurement, an idea introduced with the first appearance of the inch.

Work involving money and time will, in most cases, reinforce experiences of the home environment and, apart from the new topic of sketching maps, the work on spatial relations will continue to broaden the child's appreciation of shape.

Section F, then, provides the teacher with many opportunities to utilize the child's more mature approach to the course and to encourage him to bring a personal solution to the problems he will meet, rather than to employ a rule he does not understand.

SECTION F—LENGTH

NOTES

Formal Units

When he has reached his end of Section E the child will have had experience in using the inch, the foot, and longer informal units. These experiences will continue in Section F, the yard will be introduced as a formal unit, and the child will gain further understanding of the relationships between the yard, the foot, and the inch.

Practical situations should be utilized to reinforce ideas of fractional parts of the foot and the yard, so that just as the child was able to see that the half-pint and the one-third-pint and the half-pound and the quarter-pound were valuable units, so can the foot and yard be divided.

This idea is further used in the work involving the ruling and the measuring of lines, where lengths involving the quarter-inch, the half-inch, and the three-quarter-inch are introduced. Rulers should be clearly marked in quarter-inches and half-inches only, and the child should be encouraged to work accurately and confidently.

Measuring

Because the child will be using a larger unit, the yard, and past experiences have led him to construct equipment based upon multiple units, the field of measurement may be extended. The school-ground provides many opportunites for measurement, and this work may be linked with other areas of the curriculum :

Sport—the size of the basket-ball court, the football ground, the athletics tracks, and so on.

Science—changing lengths of shadows, distances at which sounds may be heard, and so on.

Social studies—widths of footpaths, frontages to houses, and so on.

Perimeter

It is essential that the child, prior to measuring perimeter, is given the opportunity to investigate the boundaries of two-dimensional shapes. Tracing around shapes, walking around shapes (the cricket pitch, the basket-ball court, garden beds), and drawing shapes all add to the appreciation of boundaries and provide an introduction to the measurement of boundaries, or perimeter.

Some activities may have arisen in the work of earlier sections and the aim in Section F is to allow the child to devise for himself methods of finding the perimeter. No formal rules should be given. In some instances the child will discover " short cuts " leading to the formal rule, but this knowledge should come through child-discovery, not teacher-direction or rote learning.

The child should also be encouraged to devise means of finding the perimeter without encircling the shape with string or similar material, e.g.

boxes where a ruler can be used ;

cans which can be rolled on a flat surface ;

a variety of shapes with varying numbers of sides—where all the sides are straight ; where some are curved ; where all are curved.

Link with Operations

The formal solution of problems using computation is not required in Section F. For example, where two or more lengths are to be added, the whole process must be carried out in a practical manner :

Mary's line of pencils measures 2 ft. 7 in. and Betty's line of pencils measures 1 ft. 11 in. If the child has to find the total length, the pencils are joined end to end and the total length is measured.

Similar situations can be developed for all other processes, but written computation should not be required. Any written activity is essentially that of a record.

Estimation

As has been stressed in other sections, estimation continues to play an important part in the child's approach to measuring. In Section F, attention can be focused upon this aspect when the child is asked to record both his estimate and his measured result. Some children may also be able to record the difference between these two and so obtain a clearer indication of the progress they are making in developing the skill of estimating.

The child should be able to estimate with some degree of accuracy, particularly with respect to lengths of about one foot or one yard. This ability will vary from child to child—

"This stick is more (or less) than one foot in length."

"This ribbon is about one yard long."

"My pace is almost a yard."

through to estimates which are very close to the measured lengths. It is important that opportunities should be continually presented to allow this skill to develop.

Ruling and Measuring

In Section F, ruling and measuring are still developing skills. The child will need practice in "reading" the ruler in order to ensure that he can measure accurately to the quarter-inch. Encouragement and number knowledge play important parts in this skill, particularly as the child comes to see that he does not need to have the end of the ruler always coinciding with the end of the "line" he is measuring.

Outcomes

By the end of Section F the child should—

(*a*) be able to rule and measure lines up to one foot in length, accurate to one-quarter of an inch ;

(*b*) be able to measure in inches, feet, and yards, or any combination of these ;

(*c*) understand the relationships between the inch, the foot, and the yard ;

(*d*) have some knowledge of the functional parts of the foot and the yard ;

(*e*) continue to use appropriate formal and informal units ;

(*f*) estimate, reasonably accurately, lengths of about one foot and one yard.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D and E, pages 122 *and* 149.

Notes

1. The suggested activities for Section F are presented in a more general manner than those for earlier sections, and in some instances a continuous development rather than the division into separate activities is used. This should allow teachers greater flexibility in the preparation of assignments.

2. Reference to the earlier sections will enable teachers to divide the present activities into smaller units so that a series of linked assignments may be developed.

3. Discussion between the teacher and the child, between children in a group, and general class discussion continues to be an important aspect of activity work. Estimation remains an integral part of all activities related to measurement.

4. In the work of this section, the child should be encouraged to provide some form of original record for each activity. This need not be elaborate or laboured, nor does the activity need to be " written up " in the style of a laboratory experiment. Such a record may merely consist of a single sentence, a table of results, or a sketch. At no time should this recording become formal computation.

5. The use of informal units should be encouraged so that children continue to appreciate and use ideas of appropriateness, convenience, and the arbitrary nature of formal units.

Activities outside the Classroom

With the introduction of the yard as a larger unit of measurement, and because of the child's increased maturity and sense of responsibility, it is possible for many activities to be centred on the measurement of longer lengths outside the classroom. Teachers should use every opportunity to utilize material available in the school-grounds and environs—the cricket pitch, the basket-ball court, and the shelter-shed ; distances between trees, from the front gate to the school door, from fences to the school building ; length of paths, corridors, breezeways, gardens, and school boundaries.

The children should be encouraged to measure these with informal units or by using material which will allow them to measure in the most convenient manner, as suggested in the notes on Length, Section E, page 148.

Activities with Informal Units

Part A—Introductory Activity (construction of the basic unit ; familiarization with the unit).

Take a strip of paper and, with your thumb on one end, stretch your hand as widely as possible. Mark where your little finger rests. Cut the strip on this mark. Call this length of paper a " hand ".

How many " hands " long is your desk top ?
How many " hands " tall is your table ?
How many " hands " tall is your friend ?
Guess first and then measure.
Were you correct ?

Part B—Creation of a Smaller Unit

Fold your " hand " of paper into four equal parts.
Mark along each crease line.
Call the length of each part a " finger ".

How many " fingers " long is your pencil ?
How many " fingers " long is your exercise book ?
Find two things which have a difference in length of one " finger ".
Guess first and then measure.
Find something in the room which is—

one " finger "long,
three " fingers " long,
five " fingers " long.

Part C—Creation of a Larger Unit

How many " hands " long is your arm ? Measure with your paper strip.

Take a long strip of paper and mark on it the number of " hands " it took to measure your arm. Use the nearest whole number.

Complete these sentences :

There are ☐ " hands " in one " arm ".
There are ☐ " fingers " in one " hand ".

Find things in the room which are a number of " arms " long. If you cannot do this, mark on the board or the ground these lengths—

three " arms " ;
five " arms " ;
seven " arms ".

Which is longer, an " arm ", one of your paces, or one yard ? Guess first and then measure. Arrange them in order from the longest to the shortest.

Part D—Relationship between Units

Find things in the room which are an exact number of " arms " long, or use lines similar to those suggested in Part C.

Number the lines 1, 2, and 3, or write the names of the things you have selected in this table :

Length of—	"ARMS"		"HANDS"		"FINGERS"	
Line 1	○	☐	○	☐	○	☐
Line 2	○	☐	○	☐	○	☐
Line 3	○	☐	○	☐	○	☐

Guess first and write your answer in the circle.

Now measure and write your answer in the square.

Now measure—

the length of your desk,
the width of your desk,
the length of your pencil,
the width of a cupboard,

using the unit ("arm", "hand", or "finger") that you think is most suitable. Do not worry about any lengths that are a little over or that are a little short, but round off to the nearest complete unit of length.

Make up a table for these measurements as you did for the lines above.

Can you complete this table without measuring ?

	"ARMS"	"HANDS"	"FINGERS"
My height ..	3		
Length of the table ..		8	
Length of a book ..			4

Make up a table like this and ask your friend to complete it.

Part E—Original Work

Ask the children to make up further related informal units, using body measurements, for example, a " leg ", a " shoe ", and a " toe " (the terms " foot " or " feet " should be avoided since they may be confused with the standard unit).

Part F—Further Original Work

Encourage the child or groups of children to invent further units, arbitrarily selecting the first three units or relating this to some theme. Encourage " nonsense names "—iggs, oggs, uggs, and so on.

Part G—Relation to Standard Units

Activities using the standard units of inch, foot, and yard should duplicate some of these informal activities and should be interspersed with the informal work so that each complements the other.

Note.—In the activities outlined above, emphasis has been placed upon the measuring of length and the relationship of units. It is not difficult to introduce further activities where the addition and the multiplication of length are called for. It is stressed that solutions to such problems should be discovered practically and *not* through computation. It can also be seen that activities may be developed in a similar manner for both weight and capacity.

Activities Involving the Comparison of Lengths

Provide strips of card, lino, or similar material of varying lengths. Four sets of material will allow for different levels of difficulty :

Set 1 consists of multiples of one inch.

Set 2 consists of multiples of half an inch.

Set 3 consists of multiples of a quarter of an inch but does not contain lengths which are three-quarters of an inch long or are three-quarters of an inch longer than a whole number of inches.

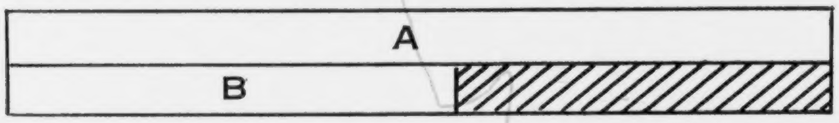
Set 4 consists of all lengths which are multiples of the quarter-inch.

Part A

Measure any strip from your set. Call this strip A.

Measure any strip you choose which is shorter than strip A. Call this strip B.

Measure the difference in length between the two strips. Cut a strip of card this length. Place your card end to end with strip B so that your strips look like this :



Write a number sentence about what you have done.

How many different number sentences can you write about the two strips and the card ?

Part B

Cut two strips of card for yourself.

Measure them and write the measurements down.

Now give the strips to your partner to work with.

Check with him the sentences he has written.

★

Measure the length of the room by pacing it out.

Measure the length of the room using a yard-stick.

Now pace the width of the room and then measure this using the yard-stick.

Complete this table :

	PACES	YARDS
Length of the room		
Width of the room		

Mark this sentence *True* or *False* :

It took more yards than paces to measure the length of the room.

Write a true sentence of your own about the width of the room.

Which is the longer, your pace or one yard ? How do you know ?

Measure. Were you correct ?

Activities Developing Skills

Use your ruler to measure the length of each of these to the nearest quarter of an inch—

your middle finger,
a pencil,
a spoon,
a large plastic stick.

Now rule lines each equal in length to one of these.

★

Draw a line 4½ inches long. From one end draw another line 2½ inches long in a different direction. Join the ends of the two lines.

How long is your new line ?

What shape have you made ?

Can you do this again so that your new third line is longer ?

Activities Involving Selection of Unit

Which unit, chosen from inch, foot, or yard, would be best used to measure—

your first finger ?
the width of your desk ?
the height of a friend ?
the length of the basket-ball court ?

★

Find someone in the class who is taller than you are. Ask your friend to stand against the chalkboard. Mark his height on the board.

Now stand in the same place and ask him to mark your height on the chalkboard.

Measure the difference in your heights. Which unit of measure will you use to do this ?

Now ask a friend who is shorter than you are to do this with you.

Choose your unit and then discover—

how much shorter your friend is ;
how much taller you are than your friend ;
any other interesting facts about your heights.

SECTION F—VOLUME AND CAPACITY

NOTES

Larger Units

As the teacher is able to set up activities where the child uses larger quantities of material, so the child should use larger containers in his handling of these materials. He should be able to select a small bucket in preference to using four one-pint bottles, one large container in preference to a number of smaller containers. In this way the child can demonstrate his grasp of the idea of using larger and more appropriate units and his appreciation of the convenience in using these.

It is at this stage that the teacher can introduce the gallon as a formal unit. Because of his environment, the child has probably heard the term "gallon", but it is also possible that he has never seen this measure in isolation. A number of activities may be centred on the gallon so that the relationship between this measure and the pint is established and understood both with respect to the pint as a unit and as a part of the gallon. Further activities may be developed so that these relationships, once understood, can be used.

Volume

In previous sections the child was given the task of packing various shapes into appropriate containers. Through this he gained some appreciation of volume with respect to the objects packed, and of capacity with regard to the container. The activities were basically designed to give experience, and no formalization of the activity was expected.

In Section F the work of earlier sections and of Section G is bridged by stacking activities. One such activity could be to stack blocks of a uniform size, then to compare the number of blocks used and the size of the completed stack. Here, without the restriction of the container, the child begins to realize the idea of volume, and this experience will form a basis for later work with solid shapes.

Outcomes

By the end of Section F the child should—

(*a*) be able to use the gallon as a formal unit ;

(*b*) appreciate the relationship between the pint and the gallon ;

(*c*) have extended his ideas of volume through packing and stacking activities ;

(*d*) be reasonably accurate in estimating quantities of about one pint and one gallon.

He went to the park

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D, E, and F, pages 122, 149, *and* 180.

Notes

The importance of estimation has been stressed for all topics of Section F. It is likely that in many activities the quantity to be measured will not consist of exact multiples of the chosen unit.

It is suggested that the child should be encouraged to record estimations as—

"☐ units", or
"☐ units and a little over", or
"a little under ○ units".

From this he can refine the estimation to "more than ☐ units" or "less than ○ units".

It will not be difficult to lead the child to appreciate the idea of "rounding off" and he will be able to say whether he is over-estimating or under-estimating.

Many opportunities should be given to encourage the child to "round up". This will be necessary, for the inclination is to under-estimate. In "rounding off" 6½ pints, he knows he *has* six pints, but the "missing" half-pint inhibits the rounding "up" to 7 pints.

Activities

Select any container you feel suitable as a unit of measure to find the capacity of the large bucket. Guess how many of your units the bucket will hold. Now measure. Now measure the capacity of the bucket using a one-pint measure. Guess first and then measure.

Record your results like this :

	MY UNIT		PINT MEASURE	
	Guess	Check	Guess	Check
Bucket ..				

Which holds the more, your unit or the pint measure ?

Find another large container and measure its capacity using another unit of measure and a one-pint bottle. Record your results.

★

Select containers which you think would hold at least two pints, four pints, and eight pints. Check, and then mark the level on each container when you have measured these quantities of water into it.

Now find containers which you think would hold two, four, and eight pints exactly. Check to see if you were correct.

★

Find four containers, each of the same size and shape, which you think will hold one gallon altogether.

How much does each container hold ?

How many pints are there in one of the containers ?

How many pints are there in—

two containers ?

three containers ?

How many pints are there altogether ?

★

Fill a one-gallon container with water.

Now find two containers of different shapes which will each hold more than half a gallon.

Divide your gallon of water between the two containers so that you think each container holds half a gallon.

Use the pint measure to check whether you were correct or not.

★

Find a can or a straight-sided jar which will hold just one pint of water. Pour in a pint of water and guess how much you think the filled can will weigh. Record your estimate, check on the balance, and record the weight.

Empty the water out of the can and fill the can with sand. How much do you think this will weigh ? More than or less than the water ? Record both your guess and the checked weight.

Now empty the can and fill it with clay. Guess the weight, record, and check again.

Order from the heaviest to the lightest the sand, the clay, and the water.

Which would weigh the most—a gallon of sand, a gallon of water, or a gallon of clay ?

Which would need the largest container—a pound of sand, a pound of water, or a pound of clay ?

Fill the can with sand again. Weigh this and record the weight.

Take one pint of water in a jug and carefully pour water into the can of sand until you cannot add any more.

If the can was filled with sand, why were you able to add water to it ?

Now weigh the tin of wet sand and record the weight. Then tip the sand out of the tin, pour any water you have left in your jug into the tin, and weigh this. Record the weight.

Now write one or two sentences about anything you have seen or discovered.

★

You will require a chalk-box, some empty matchboxes, and some small blocks. Pack the box with matchboxes. Guess how many you think you will need, pack, and then check.

How many blocks do you think will fit into the chalk-box ? Guess first and then check.

Which did you need the more of—blocks or matchboxes ?

Take another box of a different size and try again.

★

Take a rectangular cake tin and pour in water till it reaches a level of half an inch.

Now find a glass jam jar. Mark on it how far you think the water from the cake tin will reach.

Pour the water into the jar. Were you correct ?

Measure the quantity of water you used.

If you used twice this amount of water, how deep would the water in the cake tin be ? Guess and then check.

★

Pour what you think is two pints of water into a container. Mark the level. Tip this water into a one-gallon container.

Fill your container up to the mark again, and add this water to the gallon container.

How many more times can you do this before your gallon container is filled ? Guess, but do not check.

Fill your container up to the mark again and pour the water into the gallon container. Guess how much you think the gallon container holds now.

Fill your container up to the mark again, but do not pour the water into the gallon container.

Complete these sentences by adding " correct ", " too much ", or " too little ".

If all the water in my container will go into the gallon container, then the amount I estimated for two pints was ☐ or ☐ .

If I cannot pour all the water in my container into the gallon container, then the amount I estimated for two pints was ☐ .

If I pour all the water in my container into the gallon container, and this is not filled, then the amount I estimated for two pints was ☐ .

I think that the amount I estimated for two pints was ☐ .

Now check to see if your completed sentences are correct.

★

You will need six half-pint milk bottles, some beads, small marbles, and large marbles. Fill each of three bottles with water. With chinagraph pencil mark one of these bottles B. (for beads), another S.M. (for small marbles), and the third L.M. (for large marbles).

Now take the other three bottles, fill one with beads, another with small marbles, and the third with large marbles. If you were to pour some of the water from the B. bottle into the bottle containing the beads until you could not add any more water and then did the same thing with the S.M. bottle of water and the bottle of small marbles, and also with the L.M. bottle of water and the bottle of large marbles, which bottle, B., S.M., or L.M. would have the most water left in it.

Check to see if your guess was correct.

Write one or two sentences about what happened and why.

SECTION F—WEIGHT

NOTES

Teachers should refer to the notes on Weight, Section E, page 158, for a summary of the continuing themes of each section. It is important that in Section F the child should attain a good understanding of each of these and be able to use the balance with skill and accuracy.

The Ounce

With the introduction of the ounce, care should be taken in the selection of material for the child's initial weighing practice. Sand, sawdust, bran, and grains are the most suitable since they allow the child to gain a degree of accuracy not possible with bulkier or heavier material such as beads, shells, and the like.

It is possible to allow some children to discover the ounce by repeated halving of the quarter-pound. This activity can be linked to the understanding of doubling and halving and work on fractions in the pure number sections of the course. For other children it could be preferable to introduce the ounce as a formal unit and to allow them to discover the relationship between the ounce and the quarter-pound themselves.

Activities should be presented to allow all children to understand two sets of relationships—one based on the functional parts of the pound and the other based on the table of weight :

one pound = 16 ounces
half-pound = 8 ounces
quarter-pound = 4 ounces

Scales

It is suggested that in Section F the child should be encouraged to observe as many types of scales as possible, both those available in the school and those in his environment :

Postal scales for accurate weighing of small objects ;
spring balances and those designed to take heavy weights ;
the wide variety of shopkeepers' scales.

Computation

The solution of problems related to weight in Section F should be carried out in a practical manner. Once this has been done, a record can be made. Computation without reference to the practical situation is an aspect of the work of Section G.

Outcomes

By the end of Section F the child should—

- (*a*) be able to weigh accurately to one ounce ;
- (*b*) understand the relationships between the ounce, the quarter-pound, the half-pound, and the pound ;

(c) have gained in his ability to estimate weight so that he can compare, match, and estimate quantities where the differences between them are smaller than in the preceding sections.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D, E, and F, pages 122, 149, *and* 180.

Note.—As in previous sections, activities should be devised and presented so that the child can—

(i) gain an appreciation of the new unit, the ounce, thus laying a foundation for estimation of this weight;

(ii) appreciate the relationship between this new unit and those with which he is familiar;

(iii) have experience in the estimation of weights of various objects.

Activities for (i)

Provide plastic bags, balance, one-ounce weights, and materials for weighing. Weighing materials should be small-grained (e.g. rice, wheat, sand) or "light" in weight (such as bran or sawdust) so that accurate weighing is possible.

Weigh an ounce of sand.
Weigh an ounce of sawdust.
Balance the sand against some rice.
Remove the sand and put the sawdust on the balance.
What happens? Why?

This type of activity may be extended to allow the child to discover that some materials are unsuitable for measuring an ounce exactly.

Weigh one ounce of bran.
Weigh one ounce of sand.
Do they balance one another?
Can you *balance* the ounce of bran with—
    counters?
    acorns?
    bolts?
If you cannot balance with any of these things, can you write a sentence or tell your teacher why not?
Weigh two ounces of sand and two ounces of bran.
Can you balance with counters, acorns, or bolts now?
Can you tell how many counters, acorns, or bolts would weigh an ounce?

Similar activities may be developed using plastic sticks, when the child is asked to find how many small, medium, or large sticks will be needed to make one or two ounces. Some children may persevere to discover the relationships even though it may entail weighing a number of ounces.

Activities for (ii)

Provide weights of 1 lb., $\frac{1}{2}$ lb., $\frac{1}{4}$ lb., and 1 oz. The child is asked to write his estimations in the circles and the checked measurements in the squares.

You will need plastic bags, sand, sawdust, bran, and split peas. Add sand to a plastic bag until the packet weighs one-quarter of a pound. In the same way make up a packet of sawdust, one of bran, and one of split peas.

Check each quarter-pound packet with the others you have weighed out.

How many packets do you need to balance—
one quarter-pound weight ; ○ ☐
one half-pound weight ; ○ ☐
one one-pound weight. ○ ☐

What weights would you need to balance any three packets ? ○ ☐

Take your packet of sand and divide it into two packets of equal weight. Can you balance these two packets against any other single packet ? ○ ☐

Take each packet of sand and divide it into two packets of equal weight. Will these four packets of sand balance the packet—
of sawdust ? ○ ☐
of bran ? ○ ☐
of split peas ? ○ ☐

Explain your answer.

Divide your packet of bran into two packets of equal weight.

How many packets of sand balance one packet of bran ? ○ ☐
How much does one packet of sand weigh ? ○ ☐
How much do two packets of sand weigh ? ○ ☐
How much does one packet of bran weigh ? ○ ☐
How much do two packets of bran weigh ? ○ ☐

Fill the gaps :

To weigh one packet of peas I need—

○ ☐ packets of sawdust ;
○ ☐ packets of bran ;
○ ☐ packets of sand.

One packet of sawdust and one packet of peas together weigh ○ ☐

In how many other ways can you make up this weight using the packets you have ? Write down the different collections of packets which would make up this weight.

How many packets of peas would weigh 1 lb. ?
How many packets of sand would weigh 1 lb. ?
How many packets of sawdust would weigh 1 lb. ?
How many packets of bran would weigh 1 lb. ?

Activities for (iii)

Fill a matchbox with sand.

Does this weigh more or less than one ounce ?
Guess first and then check.

Fill another matchbox with counters.

Does this weigh more or less than 1 ounce ?
Guess first and then check.

Fill two more matchboxes with different weighing materials and guess whether they weigh more or less than one ounce.

Can you make any matchbox weigh exactly one ounce by taking material out of it ?

Which would weigh the most—a cupful of sand, or of counters, or of either of the other materials you used ? Guess first and then check.

Now order your cupfuls of weighing materials—sand, counters, and the two of your choice—from the lightest to the heaviest.

★

Find a wooden block you think weighs one ounce.

Find a wooden block you think weighs more than one ounce but less than four ounces.

Find a wooden block that weighs less than one ounce.

Check on the balance. Were you correct ?

Can you find something in the room which is bigger than the one-ounce block but weighs less than the block ?

Can you find something which is smaller than the one-ounce block but weighs more than the block ?

Choose first and then check with the balance.

SECTION F—TIME

NOTES

In this section the child should appreciate the role of time and time-keeping in everyday life—time-tables, television and radio programs, and the use of watches, clocks, and the timing devices that are sometimes found on domestic appliances. The child will also begin to notice time and age in relation to people in his environment—babies, children, " grown-ups ", and " old people ".

By building upon the experiences of the earlier sections, the child should also gain the skill of telling the time accurately to one minute. Parallel with this will come the knowledge that the hour is composed of sixty minutes.

This work can be extended to—

(*a*) variations in recording time, e.g.
2.15 ; ¼ past 2 ; 2.45 ; ¼ to 3 ; and so on.

(*b*) reading clock-faces marked with other than Arabic numerals.

Teachers should note the many variations used to denote the time. Many clock-faces and watch-faces replace numerals by strokes, special shapes, or marks for the quarter-hours with the intervals between being denoted by dots. City buildings often carry indicators where the time is shown by changing numerals and is read as 2.37, 5.29, and so on. Towards the end of Section F the child should have gained the skill and the understanding to record time in this way. Because of the child's familiarity with the positions of the hands and the placing of Arabic numerals, no great difficulty should be experienced in reading the time from a dial.

Some children tend to read the time as minutes past the hour, and although this can be accepted as correct, they should be able, through directed activities, to use the words " past " and " to " confidently by the end of Section F.

Estimation and Measuring

With the introduction of the minute, the child can measure more accurately the time taken to carry out particular tasks. Most of the activities used to lead the child to an understanding of duration can be adapted to give experience with definite time intervals. School and other sporting events will underline the need for accuracy in timing.

Estimation should play an important part in this work. The second is introduced in Section F and the child should experiment to devise a method which will allow him to gauge a minute.

The Calendar

In Section F the calendar can become the focus for a wide range of activities :

Read the calendar to find the date—
- of today ;
- of the first Monday in next month ;
- of the third Friday in September.

Use the calendar as a source of statistics to find—
- the number of days in each month ;
- the number of Mondays that are holidays ;
- the number of weeks in the school-year.

Link the calendar with the seasons and with weather observations.

Further work centred on the calendar would be to isolate some units (days, weeks, months), to compare facts which can be discovered about them, and to relate them to one another.

The child should be recording the date each day and should be familiar with the various forms in which it may be written. Much of the work arising from the calendar and the date can be related to current events, weather maps, and other interests outside the field of mathematics.

Ideas of chronological order and sequence will be developing further and will play a part in the work in English, particularly in news reporting and in the telling of stories.

Outcomes

By the end of Section F the child should be able to—

(*a*) estimate the duration of a minute and be aware of the second as a unit of time ;

(*b*) tell the time accurately to one minute ;

(*c*) name the months in sequence ;

(*d*) read and use the calendar.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D, E, and F, pages 122, 149, *and* 180.

Notes

1. Many of the activities of preceding sections may be adapted for use in Section F :

Activities centred on the recording or the ordering of times in fifteen-minute intervals (Section D) and five-minute intervals (Section E) may be rewritten to incorporate the one-minute interval of Section F.

Suggestions have been made in the notes on Time, Sections D, E, and F, as to ways in which the calendar may be studied. Teachers will be able to extend these activities and utilize a wider variety of topics.

2. Timing of events, as suggested in earlier sections, should continue in Section F, and in many instances the children should be encouraged to devise activities for themselves.

Duration activities may become centres of particular interest for some children, so that they attempt to make and calibrate simple forms of measuring devices similar to those suggested in Section C, page 91.

Time-tables

Provide stamped clock-faces and radio or television program guides. Allow the child to select his favourite program, indicating on one clock-face the starting time and on a second clock-face the time when the program finishes. Where the program does not go beyond the hour, the time taken for the program may be coloured in on one clock-face.

Since most television screenings are based on half-hour or one-hour programs, the above exercise merely provides an introductory activity and initiates discussion on time-tables. The class time-table could provide further opportunity for discussion and activities. Published time-tables are, on the whole, too complicated for work in Section F, and will be used in later sections of the course. However, children can be encouraged to make their own time-tables, and these can be exchanged between groups.

All preparation should be carried out with the aid of clocks having synchronized hands and should *not* develop into computational exercises. An example of this type of activity could be to make up a bus time-table for the district :

The school is situated at town A and the nearest town is B. The children might decide that the time of departure from A should be 11 a.m. and that it will take eight minutes to complete the journey to B. The hands of the clock are set at 11 o'clock and then moved to denote the passing of eight minutes. The time of arrival is recorded.

Say it takes thirteen minutes to travel from B to C. The hands of the clock are again moved and the time of arrival noted.

Children will decide on variations, such as how much time should be allowed for each stop, length of return journeys, and the like.

After the time-tables are made up they may be exchanged between groups. The objective now becomes the reading of the time-table and the recording of travel times between the various stops.

SECTION F—MONEY

NOTES

From the experience gained in handling money up to twenty cents in the earlier sections, the child in Section F extends his range to one dollar. From their environment outside the classroom most children will have handled money and be able to recognize coins and notes to two dollars at least and have some idea of value.

Teachers should continue, whenever opportunities arise, to discuss ideas of value and worth. Any aspect of money in real life which can be used as the basis for widening the child's knowledge and understanding should be utilized. Some of these situations could be :

The School Bank, particularly when the pass-books are called in for the addition of yearly interest.

Fund raising, leading to discussions centred on the amount of money that was raised, prices charged, the cost of equipment, and the best ways of using the money.

Foreign currency, shown by a member of the class and leading to discussion as to its origin, its worth in Australian currency, what it is made from, what it would buy both overseas and in Australia, and so on.

" Money stories ", e.g. early forms of currency, the reason for milled edges, and many other aspects may become not only themes for discussion but may arouse the child's interest so that he initiates a project or research activity.

It is evident from this short list that the topic of money, as with most other topics of the course, should not be confined to the " mathematics period " but should become an integral part of the curriculum as a whole.

Shopping

In Section F no limits are imposed upon shopping activities within the range of one dollar. The giving of change is an operation which calls for a certain amount of skill, and it is important that the child should be given opportunities to develop this in a concrete situation and within the limit of his number knowledge. By Section F the child is able to use a variety of units of measurement in shopping activities. Length, weight, and capacity all lend themselves to this purpose and at the same time provide opportunities for the development of an understanding of fractions.

Equivalent Value

The work on equivalent values should be built up to encompass the range from one cent to one dollar, and practice in making up stated amounts using the least numbers of coins should be continued.

Operations

No formal computation is asked for in Section F, but the operations of addition, subtraction, and multiplication should be carried out in

PEEKS
COOKIES
14c
1/5
pt
25c
40c gallon
½lb for 12
9c ¼lb

a practical manner within the range of the child's number experience. The correct way in which to write money values in dollars and cents should be taught.

Outcomes

By the end of Section F the child should—

- (*a*) know the equivalent values of coins to one dollar ;
- (*b*) be able to buy, sell, and give change to one dollar ;
- (c) be able to set out stated amounts of money, up to one dollar, in the most convenient manner ;
- (*d*) be able to write money values in dollars and cents in the correct form ;
- (e) be able to carry out in a practical manner the operations of addition, subtraction, and multiplication within the limits of his pure number experience.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D, E, and F, pages 122, 149, *and* 180.

Notes

1. Many of the suggested activities for earlier sections may be rewritten to allow for experience to be gained up to the limit of one dollar.

2. Shopping activities should continue and be extended so that the child may gain experience and skill in—

- (*a*) giving change ;
- (*b*) utilizing his knowledge of length, weight, and capacity in buying and selling ;
- (*c*) linking his shopping with money operations—addition, subtraction, and multiplication—within the limit of his pure number knowledge.

3. As in other topics of the course, the child should be given opportunites to discover relationships for himself through " open-ended " situations. This is exemplified in the first activity below, which is related to the child's knowledge of pure number. It can provide an opportunity for the child to devise his own method of recording discoveries, and the discussion of this aspect of the project will perhaps allow the teacher to suggest improvements and widen the child's appreciation of this feature of mathematics. The activity could be used as the basis for a group project.

4. The other suggested activities are in the form of games and may be readily adapted by the provision of "local rules". Care should be taken to scale these to the child's ability, particularly when it is necessary to impose a time limit. Devices other than the clock may be used for timing—

- a pierced lid sinking in a bowl of water ;
- an egg-timer, or similar device ;
- a ball running down an inclined plane ;
- a weighted string passing over a pulley.

Activities

An "Open-ended" Activity

You have four 20c coins, four 10c coins, six 5c coins, six 2c coins, and ten 1c coins.

In how many ways can you use some of these to make up one dollar ?

Record your results.

Can you arrange your results to form a pattern ?

Coin Lotto

Equipment : Cards, each marked with a value, for example, 5c, 7c, 52c, 93c, and so on up to $1.00 ; selection of coins ; counters for scoring.

Rules : One child is "caller" and calls the value of a card.
Players make equivalent values using coins.

Scoring : One counter is given to each child making the correct value.
One further counter is given to the child (or children) who has used the least number of coins.

Example : The call is for "24 cents".
Child A uses 10c + 10c + 2c + 2c.
Child B uses 10c + 5c + 5c + 1c + 1c + 2c.
Child C uses 20c + 2c + 2c.
Each child gains a counter for making the correct equivalent value.
Child C gains a second counter since he used the least number of coins.

Make It My Way

Equipment : Selection of coins ; counters for scoring.

Rules : Children take turns to set the problem using the following "call" :
"Make ○ my way using △ coins."

Scoring : Each child who is successful gains a counter.
The caller forfeits *two* counters if he cannot show a correct solution to his problem.

Example : Caller—"Make 12 cents my way using 3 coins."
Child A uses 10c + 1c + 1c.
Child B uses 5c + 5c + 2c.
Each child receives one counter.

All Change

Equipment : Cards, on each of which there is the picture of an article and its price ; selection of coins for each player ; counters for scoring.

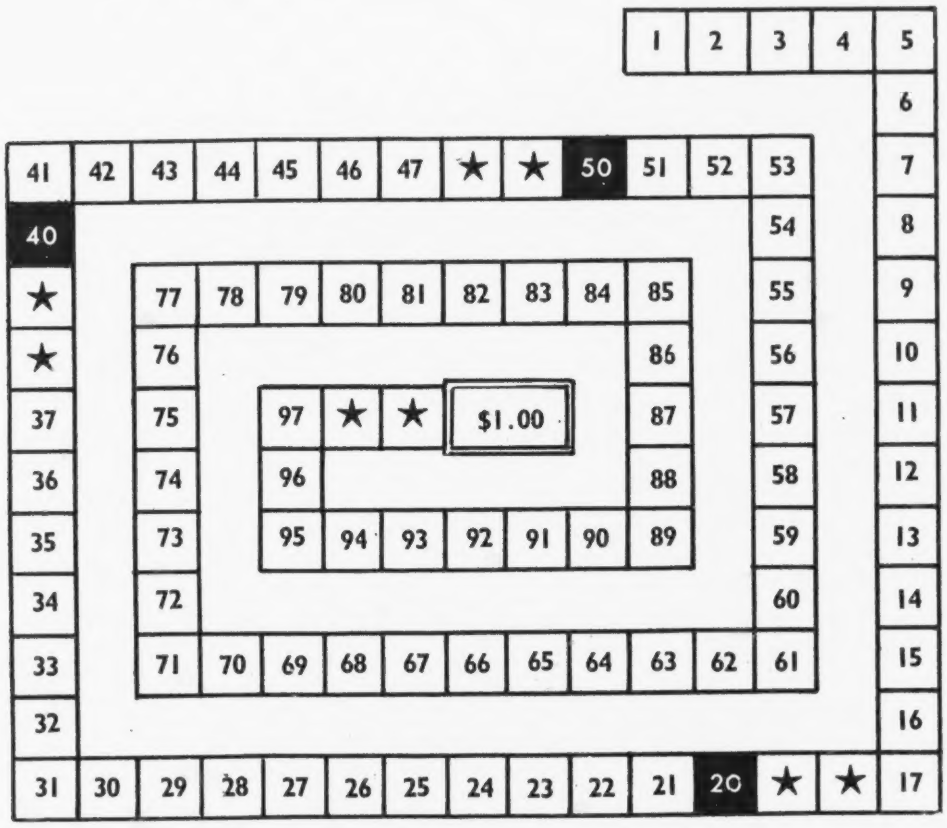
Rules : Caller selects card and says :
"I have bought this ○ for △.
What is my change from □ ?"
Players make up change to the stated amount.
Caller selects a player to give him the change.
Any player having his change made up using different coins counts it out to the caller.
Each player with the correct change gains a counter.

Example : Caller—"I have bought this model plane for 75c. What is my change from one dollar ?"
Child A counts out 5c + 20c.
Child B counts out 5c + 10c + 10c.
Each child gains a counter.

Note.— The game may be introduced using cards of low value and asking for change to 20c. Later the values may be increased and change asked for to 60c or 80c, and finally to $1.00.

Drive to the Dollar

Equipment : A prepared board as illustrated or a number chart to 100 with appropriate markings ; coins or tokens, ten of each value from 1c to 20c ; prepared cards, ten of each coin value from 1c to 20c, plus ten " blanks ". These should be shuffled and placed face down on the table. Buttons may be used to act as markers.


1 2 3 4 5
6
41 42 43 44 45 46 47 ★ ★ 50 51 52 53
7
40
54
8
★
77 78 79 80 81 82 83 84 85
55
9
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76
86
56
10
37
75
97 ★ ★ $1.00
87
57
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13
34
72
60
14
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71 70 69 68 67 66 65 64 63 62 61
15
32
16
31 30 29 28 27 26 25 24 23 22 21 20 ★ ★ 17

Rules : Each child in turn selects one coin and one card from the pack.

The sum of the coin plus the card value (in cents) denotes the number of spaces the marker can be moved.

Players *must* land on, not pass through, the 20c, the 40c. and the 50c spaces.

If a move takes the player to a starred space he may, on his next move, select only a coin which will take him to the compulsory stop.

First child to reach $1.00 wins the game.

Coins and cards are retained in front of each player and only returned to " stock " when a player is unable to move.

SECTION F–SPATIAL RELATIONS

NOTES

As in all other sections of this topic, the child continues to consolidate, extend, and revise the work of earlier sections. Thus, in Section F, he still engages in activities which centre on :

Shapes in the Environment.—Both two-dimensional and three-dimensional shapes should be related to objects seen in the world around.

Lines.—These should involve straight, curved, horizontal, vertical, and slanting lines.

Relationships between Shapes.—(i) *Formal* ; for example, triangles related to each other ; triangles joined to form rectangles and new triangular shapes.

(ii) *Informal* ; for example, the creation of new shapes by joining existing shapes.

Symmetry.—The child should discover this through observation and through creative activities.

Classification.—This should involve sorting, matching, and comparing activities to allow the recognition of similarities and differences.

Investigation of Surfaces.—This includes such activities as examining the shapes that appear when three-dimensional shapes are cut.

It is important that teachers appreciate that formal definitions should not be demanded from the child. An accurate description framed by the child and within the limits of his understood vocabulary represents a higher, and more valuable, level of achievement than a rote definition.

All the topics listed above may be developed for Section F to provide activities which are satisfying to carry out and are in keeping with the child's understanding.

Lines

Parallel lines are introduced in Section F. Many examples abound in the environment, and these should be utilized to ensure that the child understands the idea of parallel lines without formalizing the topic. The child is then able to investigate parallel lines by using the ability to rule.

By ruling a line each side of a ruler or a similar piece of wood the child is able to draw two lines parallel with each other. By drawing two further lines across the first pair, a shape is formed where the lines intersect. From this simple activity it is possible to develop an investigation into the shapes created at the intersection. By changing the position of one set of lines relative to the other, a variety of shapes can be created.

Location and Maps

From his ability to describe the locality in which he lives, the child can develop sketch maps of the area. These are not drawn to scale but should be the setting down, in a written form, of the information he is able to give orally.

Introductory work should be simple. The child should begin by making a plan of his desk or table-top to show how various objects are placed upon it. This can be extended, first to a simple map or plan of the classroom, and then to areas he knows or can check to ensure that his map is correct.

The school-grounds will provide material here, but it should be stressed that the maps are to be kept simple, basket-ball courts and extensive school-ground markings should not be included. The sketch maps should show only salient features—shelter-sheds, lawns, gardens, play areas, and the like.

As the child develops skill he will come to judge relative sizes and distances. His desk, which is probably smaller than the teacher's table, should be shown by a symbol which is smaller than that used for the table ; the area of the playground should be shown as larger than that of the garden-bed.

Shapes

During Section F, the child should become more interested in shapes related to function. As was suggested in Section E, he should continue to discover attributes of certain shapes and see why they are employed for particular purposes :

The economy of space when containers are made to fit the materials packed in them, e.g. cartons containing packets of merchandise at the grocer's, or the pyramid as used in the packaging of milk and other drinks.

Shapes, such as the brick and the wedge, and their use in building.

Outcomes

By the end of Section F the child should—

(*a*) be able to draw simple sketch maps of familiar localities ;

(*b*) recognize two-dimensional and three-dimensional shapes
  (i) which are formal ;
  (ii) which are basic to objects in his environment ;
  (iii) which have particular attributes and can serve a special function in the environment ;

(*c*) recognize in the environment, and be able to draw, parallel lines ;

(*d*) have extended his understanding of
  (i) relationships between cut surfaces and solid shapes ;
  (ii) symmetry.

SUGGESTED ACTIVITIES

Refer also to the notes on the suggested activities for length, Sections D, E, and F, pages 122, 149, *and* 180.

Notes

1. Many of the suggested activities of the earlier sections may be adapted to satisfy the increased knowledge and maturity of the child.

2. Teachers should utilize the school-grounds and environs, particularly for the work on simple sketch maps and also for many other activities that may be limited by the confines of the classroom or in which the children may lose the important awareness of " space ".

3. In Section F, children can initiate and conduct some of their own investigations, planning for themselves what they will study and the manner in which this will be carried out.

This is particularly valuable since—

- it allows a gain in confidence ;
- the informal nature of the study leads to opportunities for discussion with the teacher and within the group ;
- the teacher need assist only when asked for help although she may suggest how the study can be extended when the children need encouragement ;
- activities that are generated by a group tend to lie within the powers of that group, hence a grading takes place spontaneously ;
- the method can be carried over to investigations in pure number and also to many topics in the curriculum.

Activities

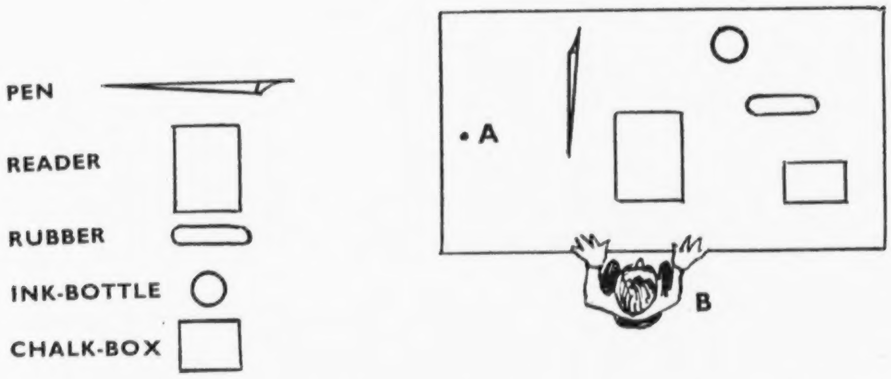
Sketch-maps may be drawn by the child. Opportunity should be given to allow the child to relate these maps to his own position to show where he stands in relation to the features on the map. Maps prepared as group projects can provide a great deal of interest.

Even in a simple exercise such as the sketch of a map of the top of his desk, the child should mark in the position where he stood or sat to gain information about the features of the map.

Imaginary maps may be created by the child, or by a group of children, and these may be used as guides for making models from clay, dough, damp sand, papier mâché, and similar materials.

While a sketch-map (or plan) may be considered as a " bird's-eye view ", pictures or models showing a " worm's-eye view " call for careful reading of the sketch-map. An activity based upon this approach could be as follows :

The child is supplied by the teacher, or a friend, with a sketch-map and legend, or key, and asked to draw a picture of what would be seen from a given position :



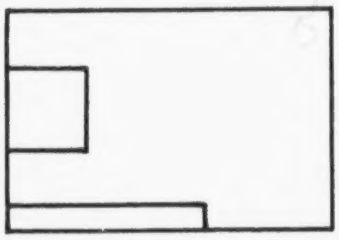
You are a spider standing at A. Draw what you see when you look in this direction : ——→

Billy, who is just tall enough to see along the table, is standing at B. Draw what he sees.

In an activity such as this the child can place objects on the table-top to match the plan, and check visually to see that his drawing is correct.

As the children gain experience, some may be encouraged to construct similar situations as puzzles or to relate them to the environment, as in this example :

Here is a sketch-map of part of the classroom. What could each shape represent ?



Such activities have added value, for they reinforce the idea of relative sizes being shown on the sketch-map and lay the foundation for the appreciation of scale.

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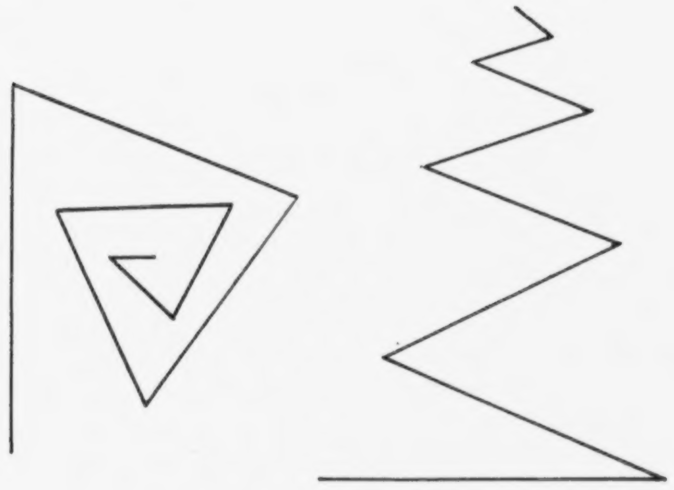
Florist's (or similar) wire provides valuable construction material. An investigation using this could be as follows :

Take a length of wire 36 inches long. With a file, or in some other way, mark it at 1, 3, 6, 10, 15, 21, and 28 inches from one end.

Now bend the wire at each mark in any direction so that when you have finished the wire will lie flat on the table.

Draw some of the interesting lines you have made.

Now try bending the wire at each mark in any direction you choose so that you make something tall.



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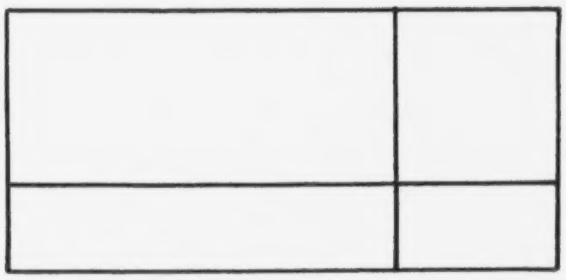
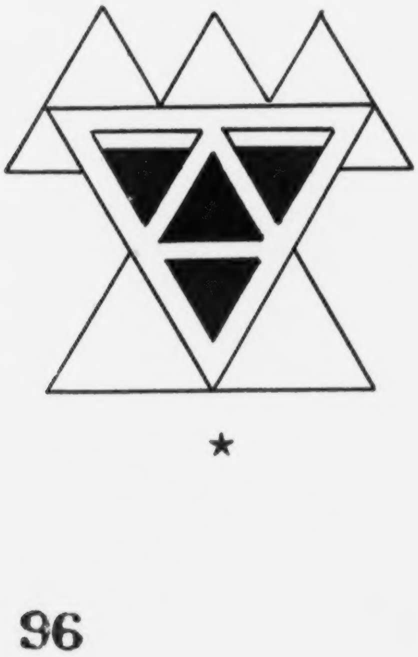
Picture puzzles calling for shapes to be discovered and identified may be presented to the child. It is suggested that these be graded and the child encouraged to make puzzles of his own for use by his friends.

Example 1 : How many oblongs can you find in this diagram ?



Example 2 : How many triangles are in this picture ?



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Provide strips of stiff card punched at each end to take paper-fasteners, some similar strips from a commercial set, or milk straws which can be joined with pipe cleaners or by inserting a folded piece of the straw at one end of each of the straws to be joined.

Join two strips together with a paper-fastener. Can you make a shape from these ?

Join three strips together. What shape can you make ? Can you change this shape ?

Join four strips together. Draw some of the shapes you can make. Can you name any of these shapes ?

See if you can discover anything unusual about the shapes that can be made with four strips.

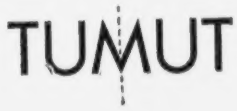
Can you draw a diagram of your discovery and discuss it with your teacher or friends ?

★

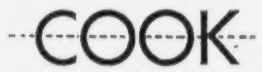
Symmetry may be investigated and used through activities such as the following :

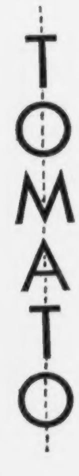
(i) Finding letters in the alphabet that are—
" horizontally " symmetrical ;
" vertically " symmetrical ;
asymmetrical.

This may be extended to the discovery of words that are—
symmetrical about an axis ;



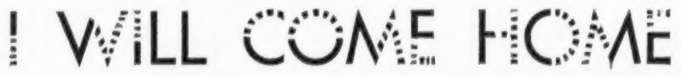
composed of " horizontally " symmetrical letters ;





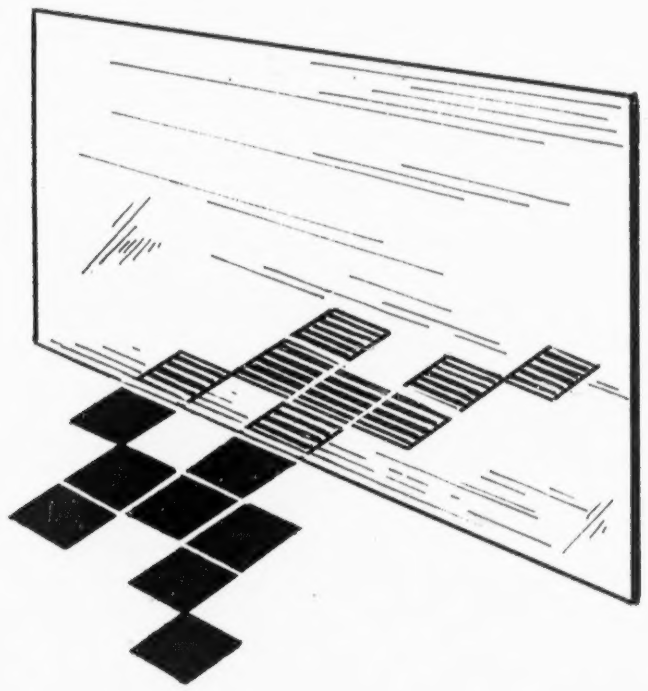
composed of " vertically "
symmetrical letters.

(ii) Writing, and decoding, secret messages.



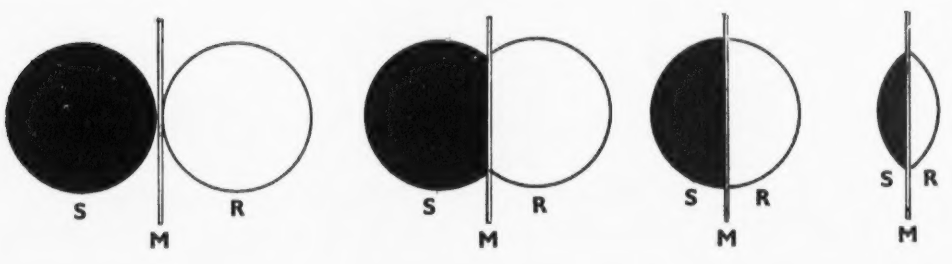
(iii) Using a pocket mirror, which may be mounted on a block of wood to keep it vertical, for the discovery of symmetrical letters, as above, or in the following activities :

(*a*) Place small plastic tiles or counters in a way that will give a symmetrical design when the mirror is used.

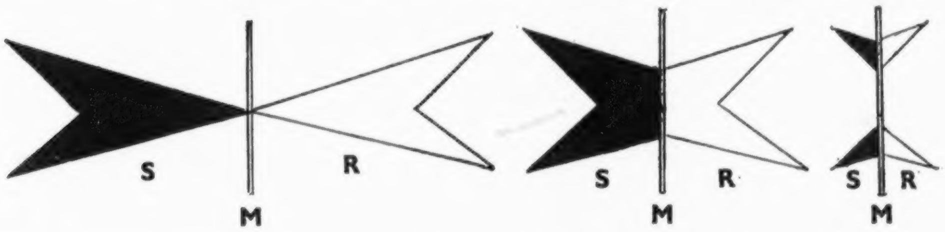


(*b*) Draw shapes and observe variations when the mirror is moved :

Regular shapes, such as the circle.



Irregular shapes or those formed by joining regular shapes.



The child should be encouraged to draw what he sees and, where possible, use the drawings in creative activities.

(iv) Collections of sketches or pictures showing symmetry in the environment—buildings, objects in the home—can be made. Nature provides many examples of symmetry—flowers, leaves, insects, etc.—and in many instances it is possible to collect examples and so provide a link with science.

★

The breaking down and reconstruction of three-dimensional figures may be carried out with the help of nets. Then by cutting out and folding the net the figure may be reconstructed.

Look carefully at the chalk-box. Cut it carefully down its edges, so that it can be "flattened" on the table-top. (This "flattened" shape is called the *net* of the box.)

Reconstruct the box by folding it back into its original shape.

From such an introductory activity, the child should go on to the sketching, and later the accurate drawing, of nets which can be folded to make three-dimensional figures.

★

An approach similar to the above activity may be used by providing squares of light card :

Join two squares of card with tape along one edge of each.

What shape or shapes can you make ? If you fold the cards along the join can you make a shape ?

Join a third card to one of the other two along an edge. How many shapes can you make now ?

Draw the shapes you *think* are possible and then test to see if you were right.

Using these three cards, can you make a shape which would hold sand ? Could you make a tunnel ? Can you make a shape that would remind you of something you see every day ?

Now join four pieces of card together in a similar fashion and see which shapes you can make.

Variations of this activity are possible if rectangular shapes or triangular shapes are substituted for the squares of card.

Exercises such as these may widen the child's appreciation of both two-dimensional and three-dimensional shapes and provide a good "lead in" to the study of rectangular solids.

★

A great deal of work can be done on solids by using blocks, and this need be limited only by the availability of the blocks. Where it is possible to obtain half-inch to one-inch cubes in good supply, the children should be encouraged to develop shapes of their own, gluing the blocks together and using them as puzzles by asking friends to replicate the shape. Much of the introductory work here can be exploratory, and when the child is satisfied that he has a worth-while shape he could be allowed to fit it together permanently.

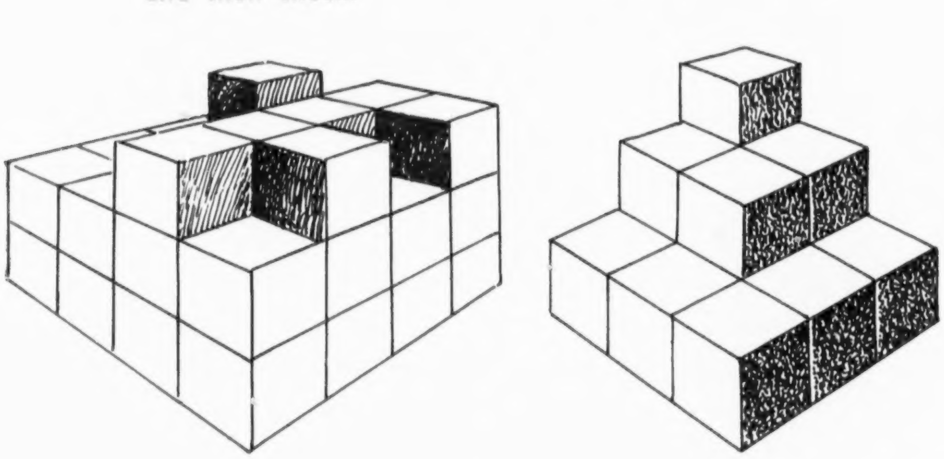
Permanent three-dimensional jigsaw puzzles may be made this way. The child may be asked to—

(i) add blocks to complete a given shape ; or

(ii) fit together pieces which are pre-glued and will assemble into a given shape.

Diagrams indicating the shape to be built may also be used to give experience with the blocks :

> Build these shapes from blocks. How many blocks are needed to make them into cubes ? Guess by looking at the pictures and then check.



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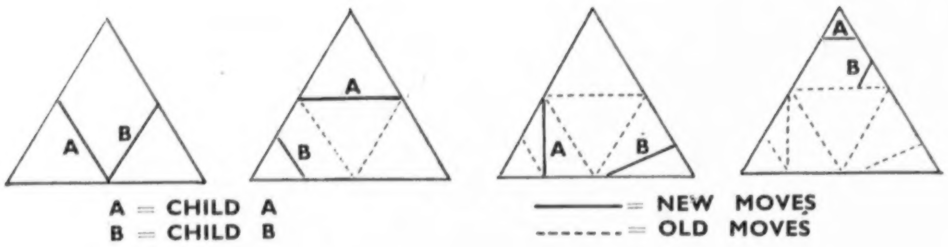
Shape Games—The Triangle Game : The game is suitable for two or three children to play together. Each child is given a "hand" consisting of 4 large, 6 medium, and 8 small plastic sticks. Each child adds, in turn, a stick to the original triangular shape to make a new triangle. The opening moves of a game played by Child A and Child B illustrate this :



The game is complete when one player uses all the sticks in his "hand". If this is not possible, the winner is the child holding the least number of sticks.

A prepared playing board may be made by gluing plastic sticks to stiff cardboard or other material. This prevents the original outline from being distorted as other sticks are added. If such a board is not available the outline may be drawn on card. Each side of the triangle requires two large plastic sticks.

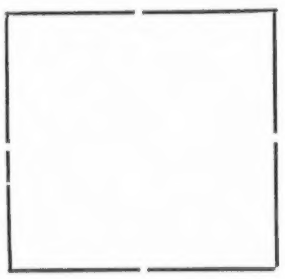
The rules of the game are :

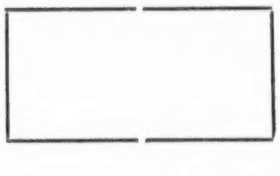
(*a*) Sticks must not cross each other or project beyond the outline ;

(*b*) sticks which are played must be placed so that both ends touch sticks already on the board ;

(*c*) sticks may be played in any order.

Variations of the game are possible by using other shapes :





In the square game only squares may be made.

In the oblong game, only oblong shapes can be made.

Nominated shapes may be added for variety, e.g. triangles and oblongs, when using the oblong board ;

any shape may be made provided it is named correctly ;

points may be given for named shapes—triangle, 1 point ; square, 2 points ; oblong, 3 points.

In the rectangular games it may be necessary for two sticks to be placed to make a shape. Interest is added if points are allotted, *one* point when two sticks are used, *two* points when one stick is used.

Children will, with experience, enjoy making "local rules" to add to the interest and the difficulty of the game.

SECTIONS A–F

STATISTICS AND GRAPHS

NOTES

Note.—Reference to the Course of Study will show that this topic is introduced in Section B through incidental activities, continued in Section C through pictorial representation, and maintained in Sections D and E. In Section F bar graphs are introduced.

Because of this, it is felt that a general approach to the topic, outlining the main features, is of more value than a discussion section by section.

Aims

To provide opportunites for the child to—

collect and sort data ;
represent data graphically or by the use of a model ;
interpret graphs.

The Collection and Sorting of Data

The collection of data in the early sections of the course will be simple, since most of this will be related to the child and his experience :

Children who live in the same street ;
the months of birthdays ;
daily weather.

As the child gains experience in his work on graphs he may want to collect more complex information, much of which can be related to other topics of the curriculum :

Traffic passing the school—to determine the busiest period of the day, the most popular make of car, and so on.

Library books—to discover the most popular books, the most popular author, the types of books available, and so on.

Science projects—weed counts, seed germination, plant growth.

Once information is collected it soon becomes evident that some form of sorting is needed in order to present the information graphically and, also, that certain characteristics must be selected so that comparisons may be made and relationships discovered.

Representation

It is important to realize that graphs are not necessarily constructed on squared paper. In fact, in Sections A–F, finely squared paper is unnecessary. When bar graphs are being constructed, paper ruled with a large grid may be convenient to save time and the tedium of ruling.

Representation is a developing process, and Figure I sets out some of the ways in which the child can utilize various activities in order to gain understanding. (See page 216.)

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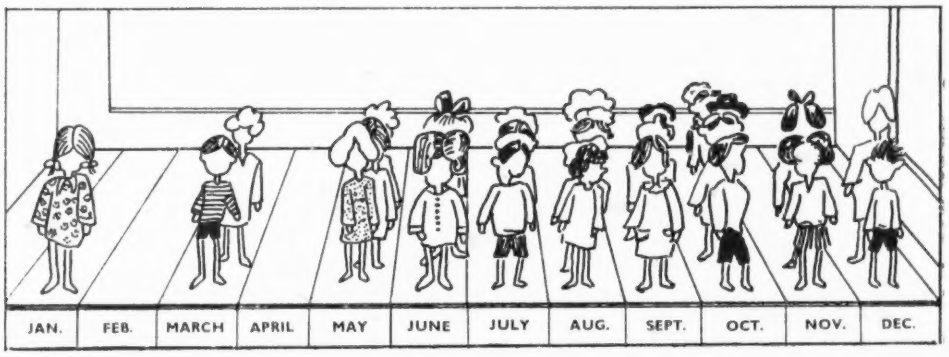
In a project involving children's birthdays, a number of different methods of recording information could be used :

(*a*) Columns, one for each month of the year, are marked on the ground or the floor. Each child stands in the appropriate column representing his birth month.

(*b*) Each child indicates his position by marking it with a cross or a circle, or perhaps by leaving his shoes in place as a marker, and then moves forward to see the result. Care must be taken to see that the children are spaced evenly before recording their positions so that a true representation is seen.



" *But, Miss, I can't see how many there are in November !* "

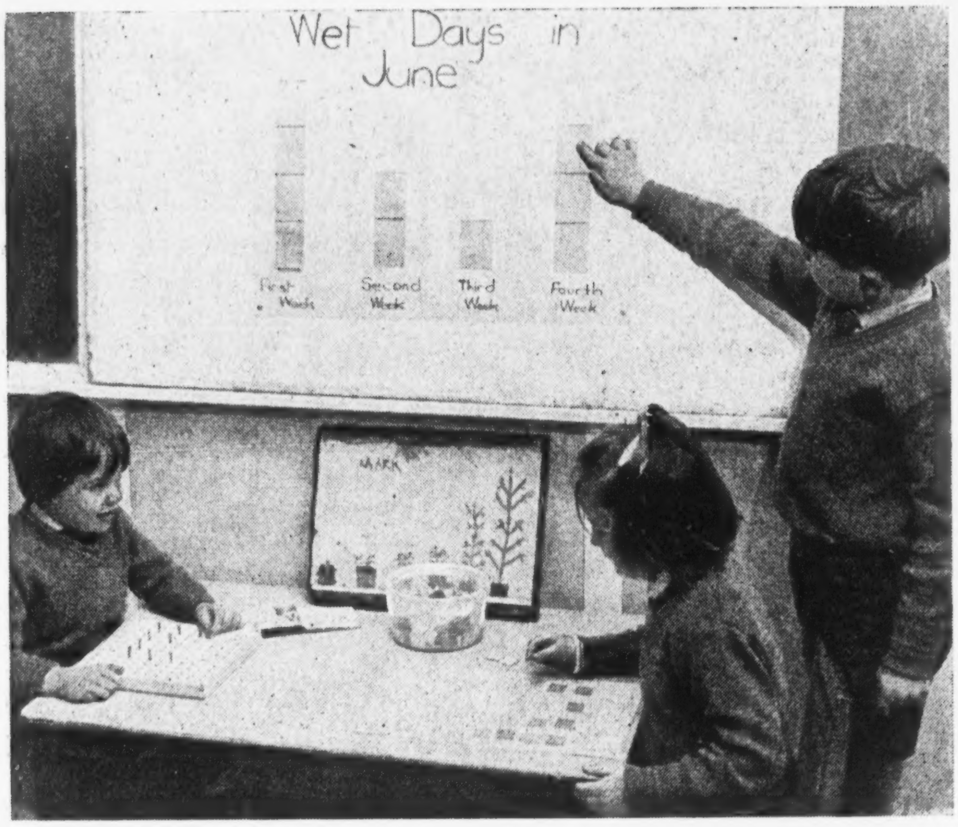
(*c*) Columns are ruled on a piece of paper. This is pinned to the display board and each child writes his name in the appropriate column ; or he draws a picture representing himself on paper of appropriate size and sticks this in the correct column ; or he places a drawing pin in the appropriate column. If the ruled paper is placed on a table, counters may be used, one for each child.

(*d*) Beads can be dropped on a series of spikes or hung from lengths of string.

(*e*) Matchboxes or Cuisenaire rods can be used to build a " model ". White rods may be used in the early stages and later replaced by the relevant coloured rods, thus providing a link with value relations in pure number. This approach may also be utilized in later sections as an introduction to the use of scale.

From all these " discrete " symbols the child can move to the more abstract ideas of using strips of paper or colouring columns to represent the data, in other words, the construction of bar graphs.

So the child moves from what may be regarded as a " one-to-one " representation (where one bead, one piece of paper, etc., represented one child) to the more abstract approach where the total number to be represented in each column is shown by a single coloured bar. It can be appreciated that the use of rods in (e) above provides a suitable link for this work.



It is not suggested that all these methods be used whenever a project is being carried out. In the early stages, the teacher will use the most appropriate method. Later, because of his wide experience under the teacher's guidance, the child should be able to select the form of representation he considers best fitted to the ideas he wishes to present.

Interpretation

The value of the work in graphs is seriously curtailed if it is restricted to the collection and recording of data. The interpretation of the graph, the discovery of relationships which were not clear at the outset, and the discovery of the reasons for these relationships are all important.

A prerequisite for interpreting graphs is the ability to discuss pictures. This begins in the preparatory grade when pictures are used to focus attention and to promote discussion, and continues throughout the school at each level and in practically every subject. Diagrams, which are symbolic rather than realistic, demand interpretation and provide a link with graphs.

Often teachers ask children to look at a picture and then imagine what has gone before, or may come after, the incident depicted. This type of activity differs from the interpretation of a graph, since the latter presents information and shows relationships which can be checked.

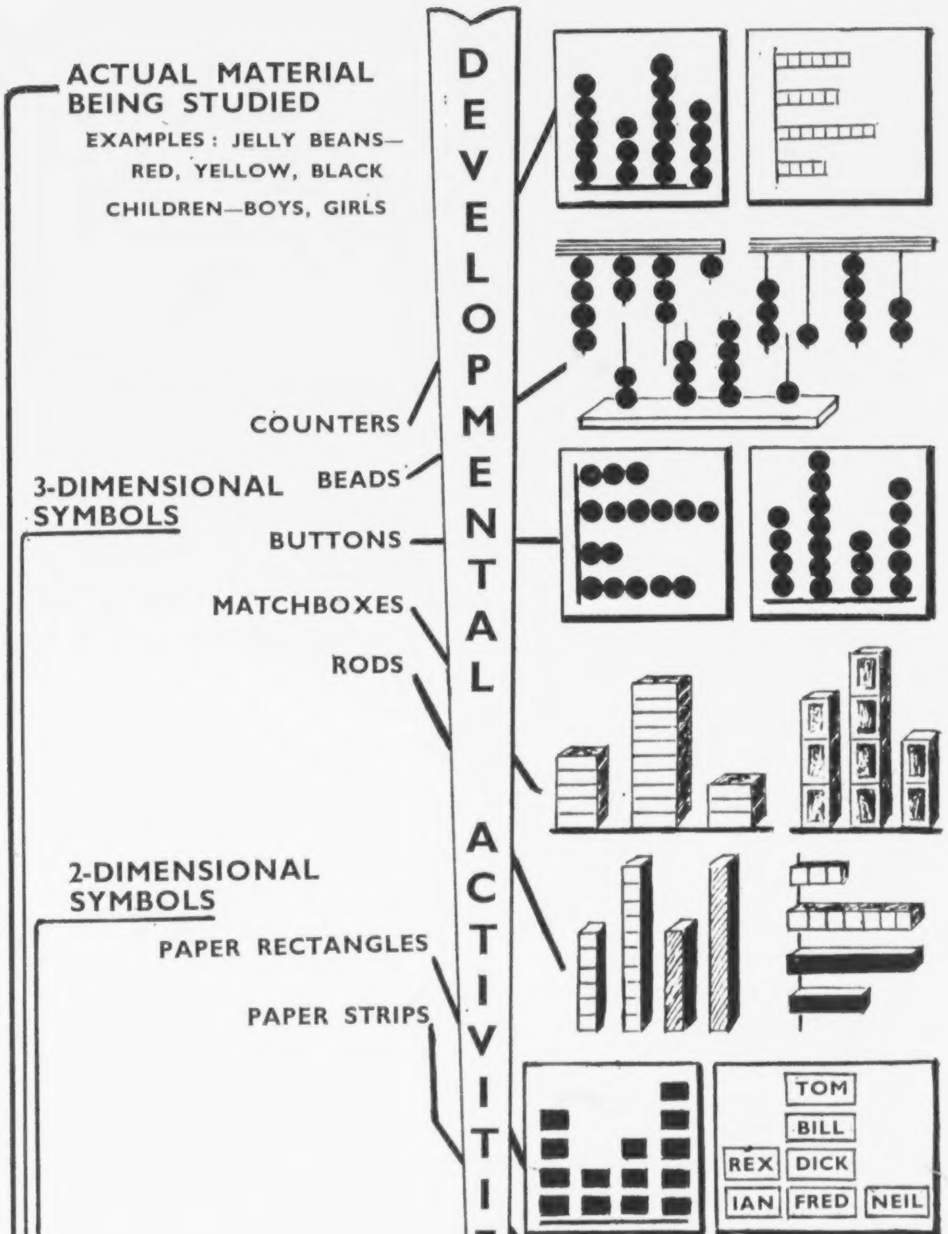

ACTUAL MATERIAL BEING STUDIED
EXAMPLES: JELLY BEANS—RED, YELLOW, BLACK
CHILDREN—BOYS, GIRLS
DEVELOPMENTAL ACTIVITIES
COUNTERS
BEADS
BUTTONS
MATCHBOXES
RODS
3-DIMENSIONAL SYMBOLS
2-DIMENSIONAL SYMBOLS
PAPER RECTANGLES
PAPER STRIPS
TOM
BILL
REX
DICK
IAN
FRED
NEIL
PICTORIAL REPRESENTATION
BAR GRAPHS
PICTOGRAPHS

FIGURE 1.

At a suitable level the calendar may be used as a centre of interest, and interpretation of the information shown can lead to valuable discussion :

How many Fridays are there in this month ?

On how many days do we come to school this month ?

What day will it be five days from today ?

Who has a birthday this month ? Mark it on the calendar. How many birthdays will there be in this month ?

This work can be extended when a yearly calendar is used.

Children should be encouraged to discover for themselves and, when they have the ability to record, to note their findings concisely. The older children may be able to take their interpretations one step further and provide reasons why certain relationships exist.

Development

The development of this topic keeps pace with the children's ability to collect, use, and interpret data. This may often be a group effort. In the early sections comparison between two columns is sufficient. Often daily weather charts are kept and these provide examples of pictorial representation. The more actively the children participate in this, the more meaningful the activity becomes.

School activities such as egg appeals or social service fund-raising provide further opportunites for work with graphs and are valuable because they relate the child's experience to the project.

As the children's interests widen and they understand the idea of graphical representation better, more symbols and columns can be introduced. This widens the opportunities for classifying data and finding a greater number of relationships, and gives greater scope for interpretation.

Figure I (opposite) attempts to summarize the development from simple " models " used to represent information through to the more sophisticated forms of pictorial representation as used in bar graphs and pictographs in Section F.

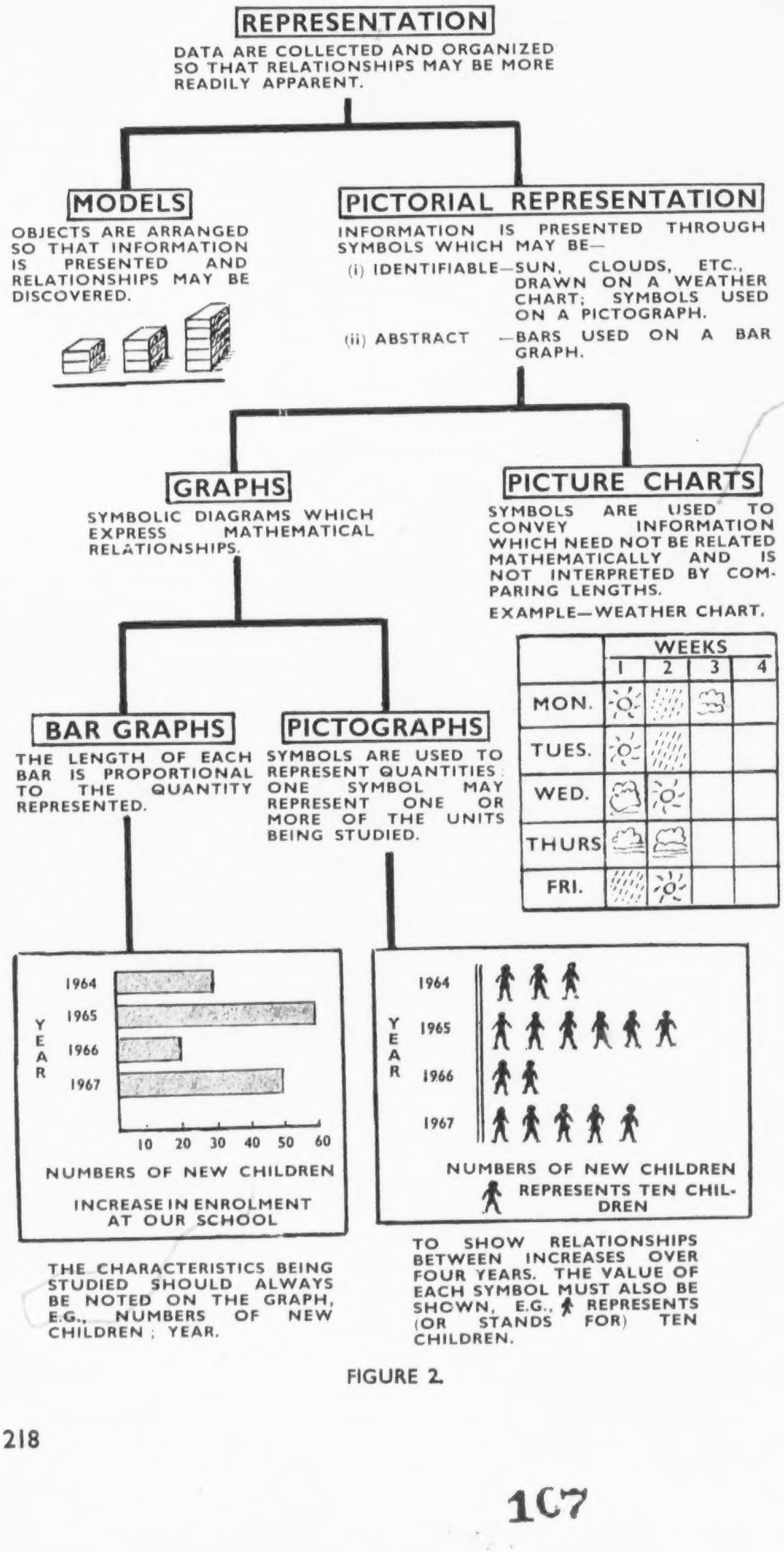
Some confusion arises from time to time because of terms used with respect to types of representation. " Picture graph " is one such term which has been variously used to describe—

(i) a type of bar graph where a bar of given height is replaced by a picture of the same height representing the subject being studied ;

(ii) a series of pictures roughly related in size to denote approximate relationships ;

(iii) a form of representation where pictures are used as symbols, such as in the classroom weather chart ;

(iv) relationships expressed by the use of small pictures, each picture representing one or more units of the material being studied.



REPRESENTATION

DATA ARE COLLECTED AND ORGANIZED SO THAT RELATIONSHIPS MAY BE MORE READILY APPARENT.

MODELS

OBJECTS ARE ARRANGED SO THAT INFORMATION IS PRESENTED AND RELATIONSHIPS MAY BE DISCOVERED.

PICTORIAL REPRESENTATION

INFORMATION IS PRESENTED THROUGH SYMBOLS WHICH MAY BE—

(i) IDENTIFIABLE—SUN, CLOUDS, ETC., DRAWN ON A WEATHER CHART; SYMBOLS USED ON A PICTOGRAPH.

(ii) ABSTRACT —BARS USED ON A BAR GRAPH.

GRAPHS

SYMBOLIC DIAGRAMS WHICH EXPRESS MATHEMATICAL RELATIONSHIPS.

PICTURE CHARTS

SYMBOLS ARE USED TO CONVEY INFORMATION WHICH NEED NOT BE RELATED MATHEMATICALLY AND IS NOT INTERPRETED BY COMPARING LENGTHS.

EXAMPLE—WEATHER CHART.

	WEEKS 1	2	3	4
MON.	☀	☂	☁	
TUES.	☀	☂		
WED.	☁	☀		
THURS	☁	☁		
FRI.	☂	☀		

BAR GRAPHS

THE LENGTH OF EACH BAR IS PROPORTIONAL TO THE QUANTITY REPRESENTED.

PICTOGRAPHS

SYMBOLS ARE USED TO REPRESENT QUANTITIES; ONE SYMBOL MAY REPRESENT ONE OR MORE OF THE UNITS BEING STUDIED.

INCREASE IN ENROLMENT AT OUR SCHOOL

🚶 REPRESENTS TEN CHILDREN

THE CHARACTERISTICS BEING STUDIED SHOULD ALWAYS BE NOTED ON THE GRAPH, E.G., NUMBERS OF NEW CHILDREN; YEAR.

TO SHOW RELATIONSHIPS BETWEEN INCREASES OVER FOUR YEARS. THE VALUE OF EACH SYMBOL MUST ALSO BE SHOWN, E.G., 🚶 REPRESENTS (OR STANDS FOR) TEN CHILDREN.

FIGURE 2.

It is considered that (i) and (ii) are unsuited to the requirements and the understanding of children in Sections A–F because of the confusion caused by area relationships between the figures.

Representation as in (iii) is referred to in this Guide as a chart, and representation as in (iv), as a pictograph. Examples are given and definitions clarified in Figure 2 (opposite).

Some indication of the development of statistics and graphs in relation to the sections of the course may be gained from the summary that follows and by reference to the topics suggested in pages 220 to 222.

Summary

Section A : Provides initial experience. Here the idea that pictures convey information is established. This is an incidental outcome from the use of pictures during story time, the use of illustrations to aid understanding, and the child's art experiences. The use of comparison in mathematics, particularly with respect to length, lays the foundation for the child to appreciate relationships later particularly as he develops the ability to order.

Section B : Incidental use of classroom situations, particularly where concrete objects are used as a means of comparison. The use of one-to-one correspondence provides a link with pure number. For example, a matchbox may be put out for each child wearing a grey jumper, and then both the matchboxes and the children counted. Again, lines of yellow buttons to represent the boys in the class and brown buttons to represent the girls may be put out. The child can see that there are more of the one colour than the other by comparing the lengths of the lines rather than by counting the buttons. The child is beginning to read results. Both counting and further use of comparison relate closely to these activities.

Section C : Pictorial representation centring on activities where charts can be used. Weather charts using symbols for sun, rain, cloud, and wind provide opportunities for discussion. For example, "Which day was sunny ?" ; "On how many days did it rain ?" ; "What kind of weather did we have last Tuesday ?"

Sections D and E : Develop the forms of representation suggested, using both models and pictorial representation. Data should be organized and arranged both horizontally and vertically.

Section F : The child moves from the use of models and pictorial representation in general to the abstract recording as in bar graphs and pictographs where one symbol can represent more than one unit being studied.

Teachers should appreciate that in all work on graphs the child is being asked to compare lengths. This basic mathematical idea as presented in the use of the rods is carried on throughout the work on graphs. Relationships are seen by proportional lengths. Value relations are important, and these lead the child through to the ideas of scale as used in Sections G, H, and I.

SUGGESTED ACTIVITIES

(Sections B–F)

These topics are in no way sequential in the order in which they are presented, the order in which they should be used, or in relation to the course itself.

Many of these topics can be used a number of times during the child's school-life, and each time the presentation can differ. For example, the number of boys and girls in the grade may be used thus—

in the developmental stages the children themselves form some type of representation ;

later, counters can be substituted for the children ;

even later in the course this can become an introductory topic to bar graphs.

In some instances the topic itself may be refined by the children to provide a number of aspects from which graphs could be built up. For example, from the general topic "Cars" the children could list the following aspects :

Makes of cars related to the number of families owning each make.

Price of car related to the type of vehicle.

Miles per gallon related to make of car.

Number of cars passing the school at given times.

Numbers of cars visiting the school each day.

Car flow—those going "up" the road, those going "down" the road.

The variety of cars passing the school—make of car related to number of that make passing the school.

Activities Centred on the Children

Topic	*Characteristics to be related*
Names	Number of children : Given names
Birthdays	Number of children : Birthday months
Ages	Number of children : Ages in years Ages in years and months
Bedtimes	Number of children : Selected times
Shoe sizes ..	Number of children : Shoe size of each child
Heights	Number of children : Height of each child
Weights	Number of children : Weight of each child
Pets	Number of children : Type of pet

Activities Centred on the School

Topic	*Characteristics to be related*
Pupil population ..	Number of boys in grade : Number of girls in grade
	Number of children : Each grade in school
	Number of boys in school : Number of girls in school
Subjects	Popularity of subject or activity, i.e. Name of subject or activity : Number of children who like it best
	Name of subject : Amount of time spent on it each day or each week
Library	Well-known books : Number of children who have read each one
	Titles of books : Number of children who liked each one
	Categories of books : Numbers of books in each category
Music	Named songs : Numbers of children for whom each is a favourite
	Popular records, groups, singers, etc. : Numbers of children for whom each is a favourite
Social service ..	Daily results for egg appeal
	Amounts raised for different causes or from different activities
Bank	Class totals over a number of weeks
	Totals for various classes on the same day
Absences	Numbers in grade each day of the week
	Numbers in different grades on a given day
	Numbers in the school (i) daily (ii) compare weekly totals for a month

Activities Centred on the Family

Topic	*Characteristics to be related*
Children in the family	Number of families : Numbers of children in each
Fathers' occupations	Selected occupations : Numbers of fathers engaged in each
Social interests ..	Numbers of children interested : Selected activities such as Guides, Scouts, etc.
Football teams ..	Selected teams : Supporters for each team
Television viewing ..	Selected programs : Numbers of children viewing each
	Time spent viewing : Numbers of children

Activities Centred on the Family—*continued*

Topic	*Characteristics to be related*
Favourite lollies, ice-creams, drinks, etc.	Selected choices : Numbers of children preferring each choice
Cars	See suggested activities in introduction above
Saturdays	Selected activities : Numbers of children engaged in each
	Selected activities : Time spent on each

Activities Centred on Other Interests

Topic	*Characteristics to be related*
Nature study and science	Weed population in a given area, i.e. Types of weeds : Numbers of plants
	Seed germination—one hundred seeds on damp blotting paper, mark paper to show seed has been counted once it germinates : Plot number of seeds germinating each day
	Growth in height of plant each day
	Increase in root length every two days (use onion on a jar of water)
	Burning candle, height at regular intervals
	Distances at which various sounds can be heard—tuning-fork, C on recorder, triangle struck lightly, etc.
Social studies ..	Heights of mountains, lengths of rivers, distances between cities, populations, and other information can all be graphed
	Production of a commodity over a number of years (local industries may prove interesting)
	Import and/or export figures over a period
The alphabet ..	Letter frequencies on a page
	Word frequencies on a page
	Numbers of words to a page
Just for fun ..	Lollies—colour distribution in a packet
	Raisins in slices of raisin bread (note that the problem of " raisin " will have to be overcome, " What do we do to count the pieces of raisin ? ")
	Letter distribution in alphabet noodles
	Number of matches in each box in a packet of matches. Do the results justify the claim "Average contents . . . " ?

VOCABULARY

(Sections A–F)

This vocabulary is intended as a check-list of words children should know and understand up to the end of Section F.

It is not prescriptive, nor is it necessarily complete. Much of the child's vocabulary comes from adults and older children in his environment, and this can cause variations from one area to the next. There are many places throughout Victoria where certain words are significant because of the locality or local industries :

> "A stand of timber", "super feet", "four by two", are commonplace terms of the timber areas, are within the understanding of a young local child, and are important in his vocabulary.
>
> To a city child, such words could be outside his vocabulary and understanding until after he has completed Section F.

It could be of advantage to the teacher to list these regional words as part of this vocabulary.

The words are listed in alphabetical order and it is suggested that teachers may find it more useful to select the words appropriate to the section they are using and re-list them according to topic or order of difficulty so that they may be readily referred to and perhaps used more effectively.

It will be noted that while such words as cent, inch, ounce, and gallon can be listed as referring to specific topics of the course, many other words are used with reference to more than one topic and hence are difficult to place in categories.

A further suggestion is made, that teachers, having selected and used certain of the words here listed, should note them for the information of the teacher in the following grade.

Because some words vary in meaning according to the context in which they are used, it is important that teachers should use such words appropriately to allow the children to appreciate the different meanings :

For example—

one *foot* long ;
at the *foot* of the stairs ;
his right *foot*.

No degrees of comparison (big, bigger, biggest) are listed.

Brackets, ( ), indicate that words may be added to complete an expression, as in "a little ( )"—

a little *more* ;
a little *less* ;
a little *taller* ; etc.

about
about the same
above
across
add
afford
after
afternoon
again
age
alike
a little (   )
all
all day
all of it
almost (   )
along
altogether
amount
angle
ankle
another
answer
apart
arch
arm
around
arrange
as (   ) as
autumn

back
back to back
backwards
balance
ball
bar graph
before
begin
beginning
behind
below
beneath
beside
between
big
big enough
birthday
bit
bit longer
block
blunt
border
both
bottom
boundary
box
broad
build
buy
buyer

calendar
carry
cash
cash register
cent
centre
change
cheap
check
choose
circle
circular
clock
close
coin
cold
column
combine
compare
conductor
cone
contain
cool
corner
correct
cost
count
crooked
cube
cup
cupful
curved
customer
cylinder

date
dawn
day
days (names)
dear
deep
depth
diagram
dial
diamond
difference
different
difficult
disc
distance
divide
docket
dollar
double
down
draw
dusk

each
ear
early
earn
edge
empty
end
end to end
enough
(   ) enough
enough (   )
equal
equals
estimate
even
evening
exact
expensive
eye

face
face to face
far
fare
fast
feels
feet
few
fill
find
finger
finish
first
fit
flat
foot
forward
fraction
from
from (   ) to (   )
front
full

gallon
gap
glass
glassful
go
graph
great
group
guess

half
half full
half-hour
half-pint
hand
handful
hard
head
heavy
height
here
high
horizontal
hot
hour
huge
hurry

in
in a little while
in from
inch
inches
inside
into

jar
jarful
join
just right

kite-shaped
knee
knot

large
last
last ( )
late
later
least
left
leg
length
less
level
light
lighter than
like
line
liquid
little
little ( )
long
long time
looks
lot
low
lunch-time

many
match
measure
midday
middle
middle-sized
midnight
mile
minute
model
money
month
months (names)
more
more than
morning
most
mouth
move
much ( )

narrow
near
nearly ( )
next
next to
night
none
noon
nose
not ( )
notes
now

oblique
oblong
o'clock
odd
once
on top of
opposite
order
ounce
out
outside
oval
over

pace
pail
pair
part
pattern
pay
pictograph
piece
pint
playtime
point
pointed
pound
pour
price
pull
push
put in order
put together

quantity
quart
quarter
quick
quickly

ready
record
rectangle
rectangular
remove
right
rough
round
row
rule
ruler

same
same as
save
season
seasons (names)
second
sell
seller
set
several
shallow
shape
share
sharp
shop
shopping
short
short time
side
side by side
sideways
size
slant
slope
slow
slowly
small
smooth
so ( )
soft
sold
solid
some
some of it
soon
sort
sour
space
span
spend
sphere
spill
spoon
spoonful
spring
square
star
start
step
stop
straight
stride
strip
subtract
surface
sweet
swift

table
tablespoon
tablespoonful
take away
tail
teaspoon
teaspoonful
tell
there
thick
thin
third
tie
time
time to
tinful
tiny

today
together
tomorrow
too ( )
top
tower
triangle
triangular
turn
twice
twilight

under
underneath
uneven

unequal
unit
up
upside down

value
vertical
very

wait
warm
watch
way

wedge
week
weigh
weight
when
whole
wide
width
winter
worth

yard
year
yesterday

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